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the billpayer's guide to furnace servicing

HOW TO SAVE MONEY AND CANADA'S ENERGY RESOURCES BY PROPER FURNACE SERVICING

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HOW TO SAVE MONEY AND
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Printed by Universal Printers Ltd.
Contract No. 02KT.23384-7-6722

©
Information Canada
Ottawa, 1975
Cat. No.: M-27-10/1975

Fifth Printing January 1978

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ACKNOWLEDGMENTS

The Office of Energy Conservation of the Department of Energy, Mines and Resources wishes to thank the staff of the Canadian Combustion Research Laboratory of the Department of Energy, Mines and Resources and especially Dr. David Brown for invaluable help in preparing this book. Thanks are due also to the staff of Information EMR for assistance in publishing.

Acknowledgment and appreciation are also extended to the Canadian Gas Association and the Ontario Petroleum Association for comments on the technical content of this book.

introduction

What's so important about having an efficient furnace?

Well, if you're like most Canadians, over half of all the dollars you spend each year on energy in your home goes into heating. So it makes sense to have your furnace working economically and efficiently.

There are basically three ways to cut your fuel bills:

Thermostat setback

This means generating a little less heat by cutting your thermostat back by a few degrees. If you are used to having the thermostat at 72°F (22°C), try setting it at 68°F (20°C) during the day and 63°F (17°C) at night (with an extra blanket on the bed). These steps alone could save you 15 per cent on your heating bill.

Improved home insulation

Keeping the heat inside, where you want it, is very important too. Insulation, weatherstripping, storm doors and windows are certainly a worthwhile investment; they can cut your fuel bill anywhere from 10 to 50 per cent for years after installation.

These items are covered in much greater detail in the book *100 Ways to Save Energy and Money in the Home*. If you don't have one, order your free copy using the coupon at the back of this book.

Proper furnace servicing

Make sure your furnace, be it oil- or gas-fired, is properly serviced and operating at peak efficiency.

That's what this book is all about: *saving your money and Canada's energy resources by proper furnace servicing.*

It shows what you can do.

It shows what your serviceman *should* do.

Until now, there hasn't been much information available to help the billpayer understand just how to improve his furnace's efficiency. This book illustrates all the steps and operations that should be part of an annual or semi-annual overhaul. It provides both you and the serviceman with a handy way of calculating your furnace efficiency at the time of overhaul. It indicates the standards of performance that can be expected from the various types of residential oil- and gas-heating equipment.

After you've read the book, you'll be in a position to make sure that your furnace system is receiving the care and attention it needs for maximum efficiency. The same information applies to gas- and oil-fired water heaters.

You'll save some money and Canada will save some much-needed energy!

how to use this book

Read the book

If your home is heated with oil, see Chapters 1, 3, 4 and 5. If it's gas-heated read Chapters 2, 3, 4 and 5.

Get your furnace serviced (and your water heater too)

Call your fuel supplier or local furnace service company for an annual overhaul and servicing. This book shows you step by step what should be done by the serviceman. You can get him to check off the various steps on the enclosed checklist and you can calculate the efficiency after he has finished tuning it. The chart provided will tell you if this is reasonable for your type of furnace.

If you have already had an annual overhaul, did the serviceman perform all the steps outlined in this book? If you are not satisfied consider having him back.

If your company does not provide satisfactory service, switch to another.

When you have a good serviceman, be guided by his judgement.

Investigate other methods of increased efficiency

Discuss with your serviceman the other opportunities for improved efficiency that are outlined in Chapter 3.

Make your own contribution

Chapter 4 outlines what you can do by ways of self-servicing and monitoring to keep your furnace operating efficiently.

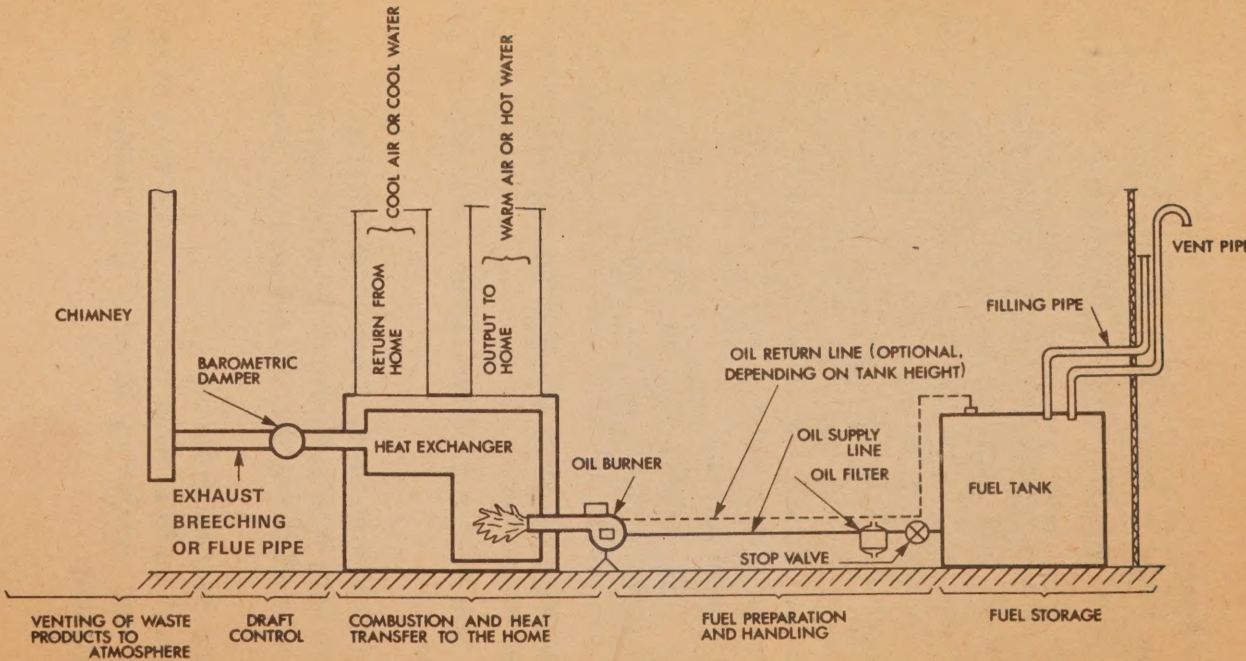


Figure 1.
Schematic illustration of the components of an oil-fired residential heating system.

1, oil-fired heating systems

The majority of Canadian homes, especially the older ones, are heated by oil furnaces.

In the conventional model, heating is achieved by mixing a spray of oil droplets with air and igniting it to give a flame. The fuel should burn completely to give the most heat. The oil-air mixture should use the minimum quantity of air that will deliver a "clean" flame. Smoke at the tip of the flame will cause soot and waste heat.

The heat generated from the flame heats the metal surfaces of the heat exchanger which transfers the heat to the circulating water or air in the home-heating system. While this is going on the products of combustion are removed from the home through the exhaust breeching and chimney.

Figure 1 shows the component parts and their functions in an oil-fired residential heating system. All parts should receive attention during the annual, or if needed semi-annual, overhaul.

THE ANNUAL OVERHAUL

Stage 1: EIGHT VISUAL CHECKS

When the service mechanic arrives, these are the first examinations he should make. They will help him suggest preventive measures and avoid expensive return visits during the winter.

Step 1: Filling and vent pipes

These are outside the home and must be in good mechanical condition. The vent pipe should be free of

Figure 2.
New, well-installed exhaust breeching.

Figure 3.
Corroded and badly installed exhaust breeching in need of replacement.

accumulated debris, with good connections to the storage tank. No visible cracks or leaks.

Step 2: Fuel-level indicator

The dip-stick should move freely to accurately record the fuel level in the tank.

Step 3: Oil lines

These should be inspected carefully. Signs of regular spilling at the filter or burner can mean poor combustion performance. Furnace oil is quite volatile—the penetrating odour will tell you that—and may present a fire hazard in extreme cases. Any leakage should be eliminated.

Step 4: Exhaust breeching

The purpose of the exhaust breeching or chimney pipe is to lead the products of combustion safely from the furnace to the chimney. Connections should be strong and air-tight, free from any restrictions.

The new breeching in Figure 2 is in good condition.

That shown in Figure 3 is in poor condition and should be replaced; leakage from the holes presents a safety hazard to residents.

Step 5: Furnace casing

The outside of the furnace should be checked for signs of soot deposit. The presence of soot may indicate that the available draft is inadequate, or that the ignition electrodes are poorly positioned, causing ignition with a puff or minor explosion.

Step 6: Warm-air ductwork

Ductwork connections to the furnace and all visible ductwork joints should be tight. Air leakage at the humidifier (where this is fitted on) should be eliminated.

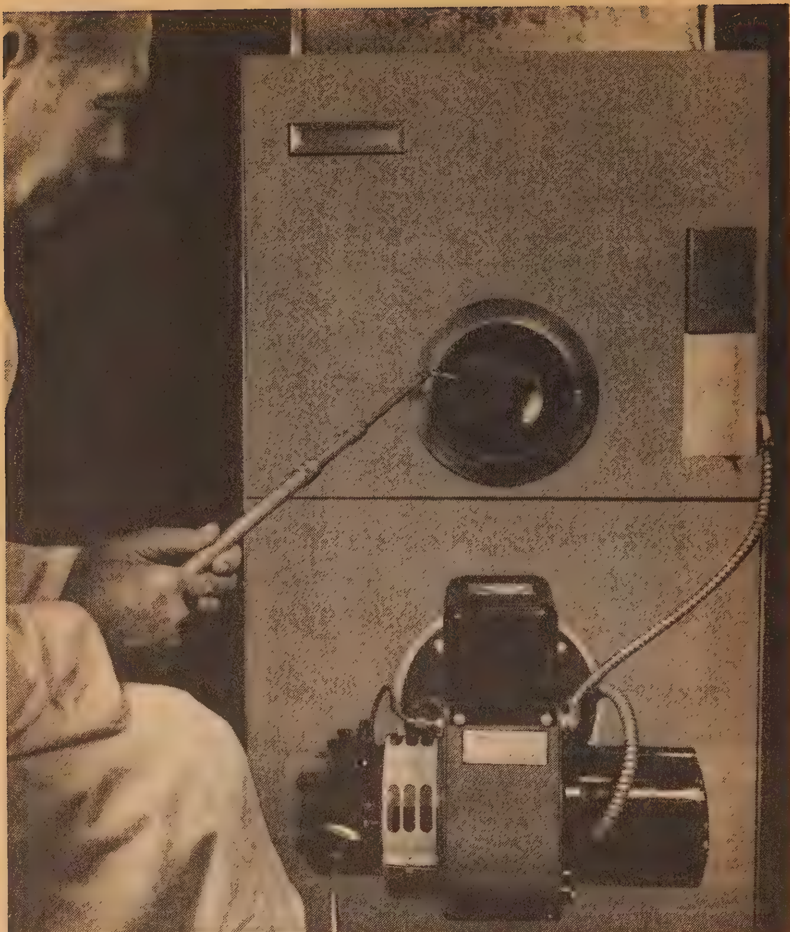


Figure 4.
The burner serviceman preparing to inspect the interior of the furnace with a flame mirror.

Step 7: Hot-water pipes

If you have a hot-water boiler there should be no evidence of water leakage at any of the piping connections to the boiler.

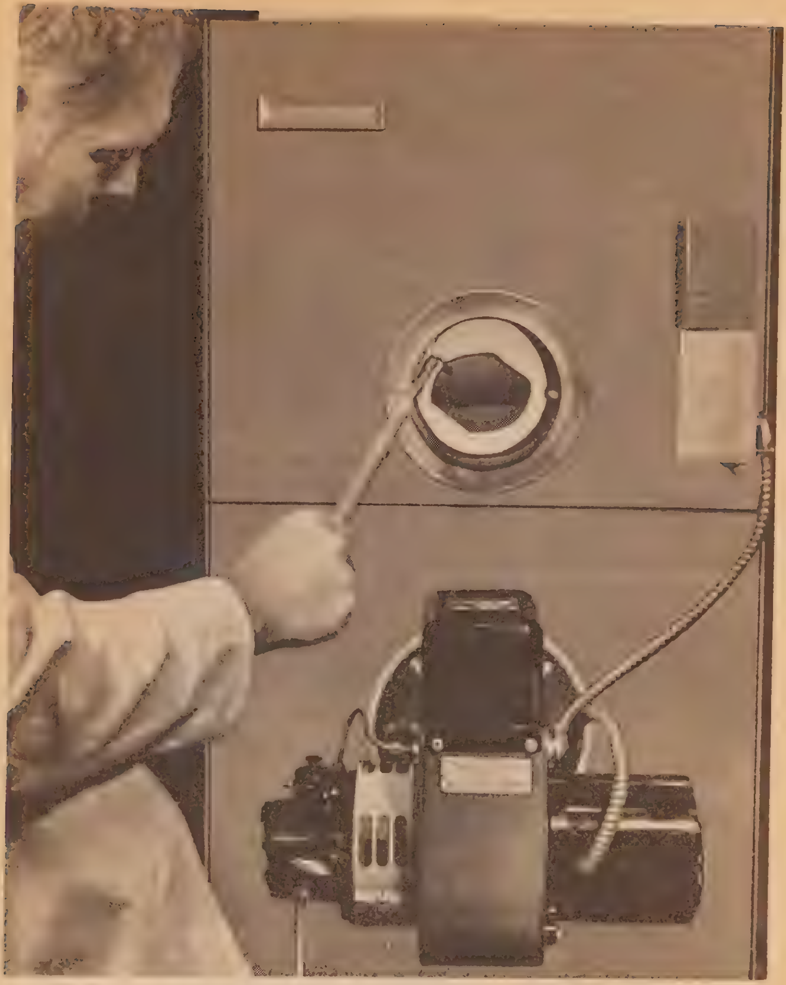


Figure 5.
The flame mirror is inserted through the inspection door to view the flame and combustion chamber.

Step 8: Preliminary operation of the furnace

The burner's job is to inject fuel and air into the furnace, ignite it safely and burn it completely. Burning takes place in a special combustion chamber. As well as producing heat, it produces light which helps the

service mechanic to see the internal surfaces of the chamber and the condition of the flame.

He uses a flame mirror (Figures 4 and 5) to carry out these checks:

Burner operation: Ignition and operation should be quiet and odourless.

Flame condition: The flame should be symmetrical.

Combustion chamber inspection: The refractory (or stainless-steel) walls should be rigid. No signs of crumbling or cracking.

After making these eight visual checks, your serviceman is now ready to carry out the major service operations: *furnace overhaul, burner overhaul* and *burner adjustments.*

Stage 2: FURNACE OVERHAUL

Furnace overhaul is basically a cleaning operation. At least once a year the accumulated soot deposits should be removed from the furnace and the stack control. These deposits act as insulation on the heat-exchanger surface and decrease heat transfer to the home.

The first step is to disconnect the burner/furnace power supply—either at the fuse panel or power switch.

Step 1: Exhaust breeching. If the visual check shows that the exhaust breeching is holding up, it can be removed and cleaned. A check of the inside should confirm its good condition.

But if the service mechanic suspects it should be replaced, he'll confirm this by inspecting the interior and advise the billpayer that new breeching is needed.

Step 2: Barometric damper.

> This "swinging door" is usually set in the breeching between the furnace and the chimney base. It maintains a constant draft at the furnace outlet and all oil furnaces should have one that is certified by CSA.

Normally the barometric damper is in the "closed" position when the furnace is off, as in Figure 6, and moves to a partly open position, as in Figure 7, when the furnace is running.

The face of the damper should be vertical when the chimney is cold; the pivots on which it hinges should be horizontal. The damper should swing easily. Pivots and sockets can be cleaned with a wire brush as needed and lubricated with a single drop of oil.

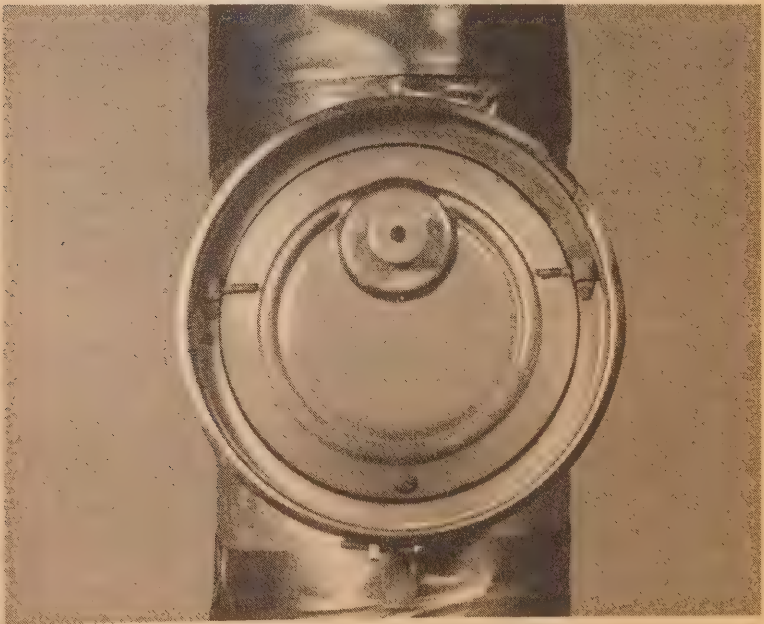


Figure 6.
The barometric damper in the closed position when the furnace is not running.

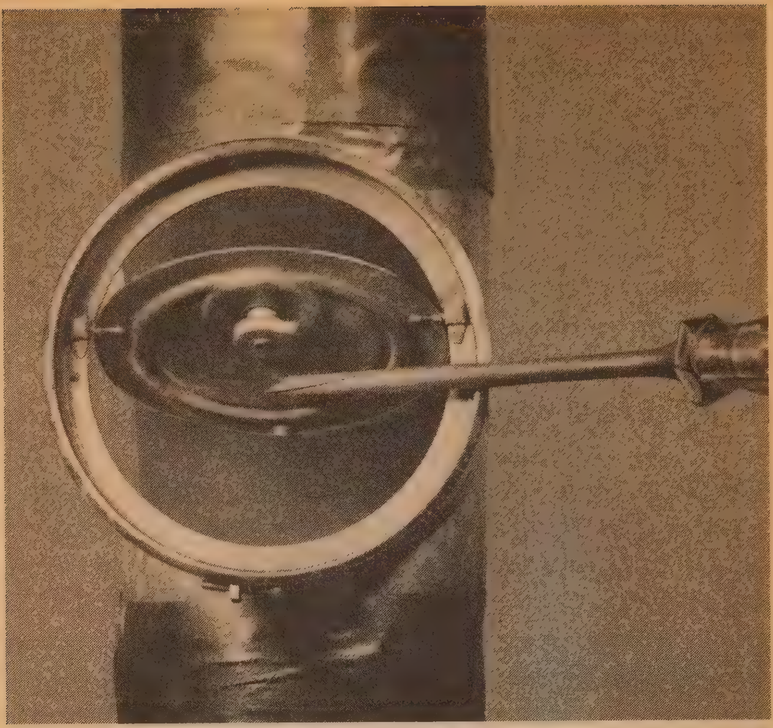


Figure 7.
The barometric damper in the open position when the furnace is running.

Step 3: Stack controller. This is a primary safety control. If the flame is extinguished, it cuts off power to the burner and prevents unburnt fuel from accumulating in the combustion chamber. It a stack controller (protector relay) is fitted to the system, this must be cleaned. It's located either in the upper part of the furnace or in the exhaust breeching between the outlet from the furnace and the barometric damper.

The stack controller should be removed, cleaned with a soft brush, and inspected. Figures 8, 9 and 10 show its position and the cleaning operation.

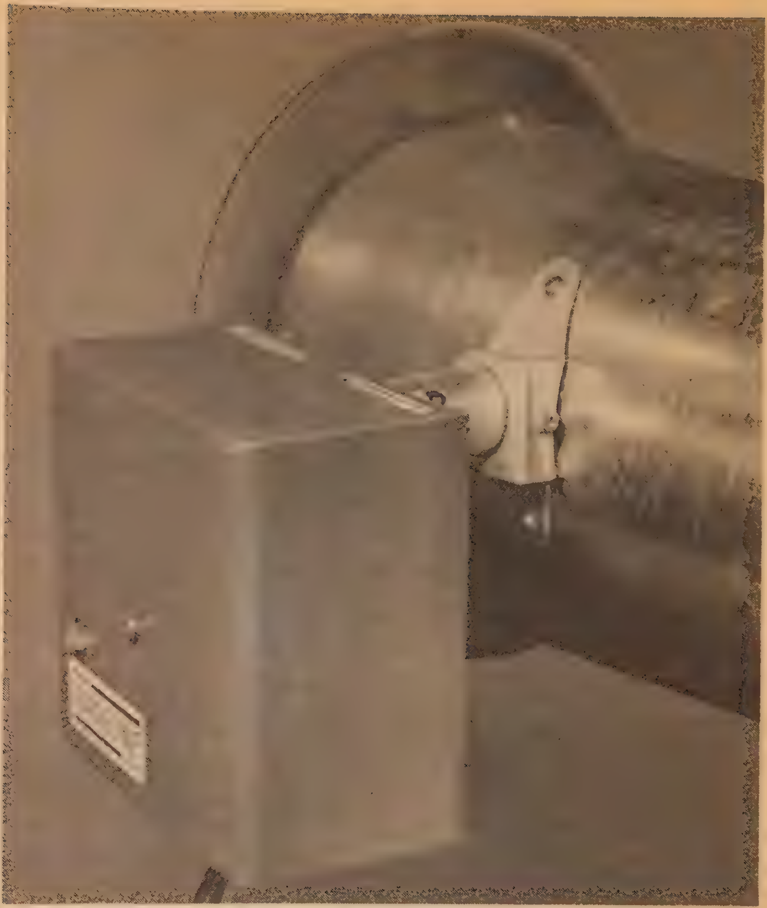


Figure 8.
The stack controller located in the exhaust breeching.

Step 4: Chimney base. Building codes require that exhaust breeching extend through the chimney wall and be flush with the inner face of the chimney. The joint between the breeching and the vertical chimney should be cleaned out with a vacuum cleaner.

Step 5: The furnace's internal surfaces. This is the most time-consuming part of the entire operation. The in-

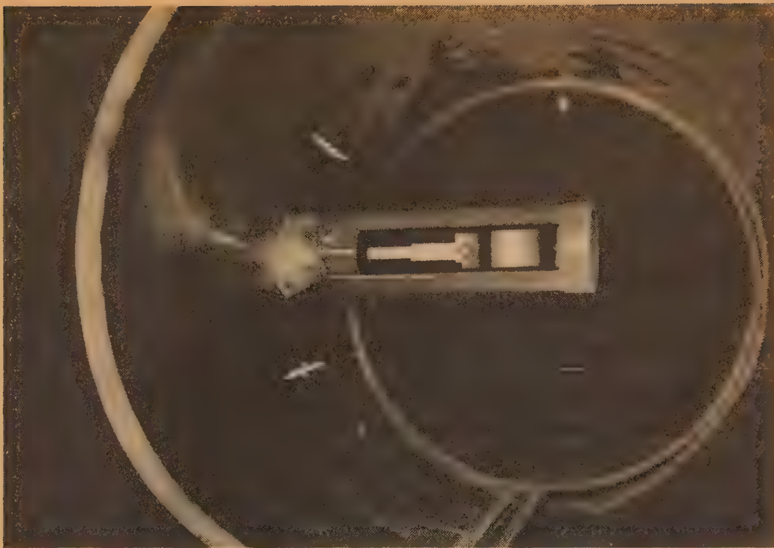


Figure 9.
The temperature-sensitive head of the stack controller is exposed to the exhaust gases in the exhaust breeching.

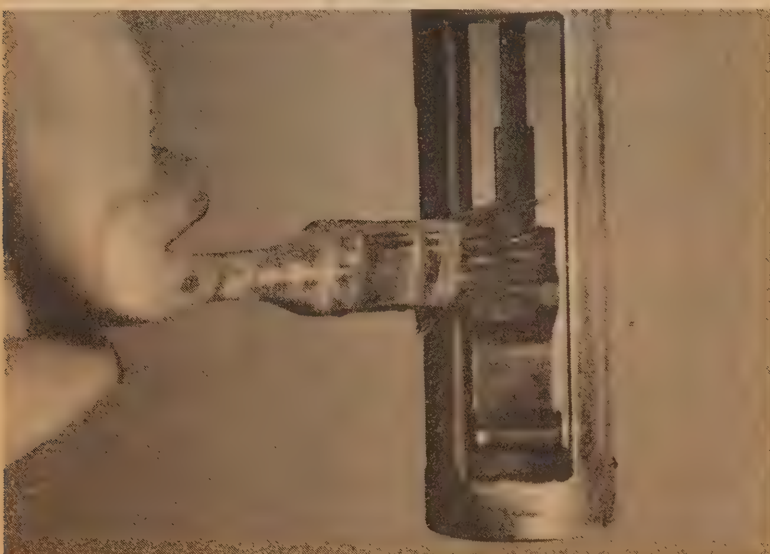


Figure 10.
Cleaning the stack controller with a brush.

ternal metallic surfaces of the furnace have to be scrubbed with a wire brush and the soot vacuumed out. The most common access opening is through the furnace exhaust (Figure 11).

Figure 11.
The most common access for furnace cleaning is by removing the exhaust breeching.

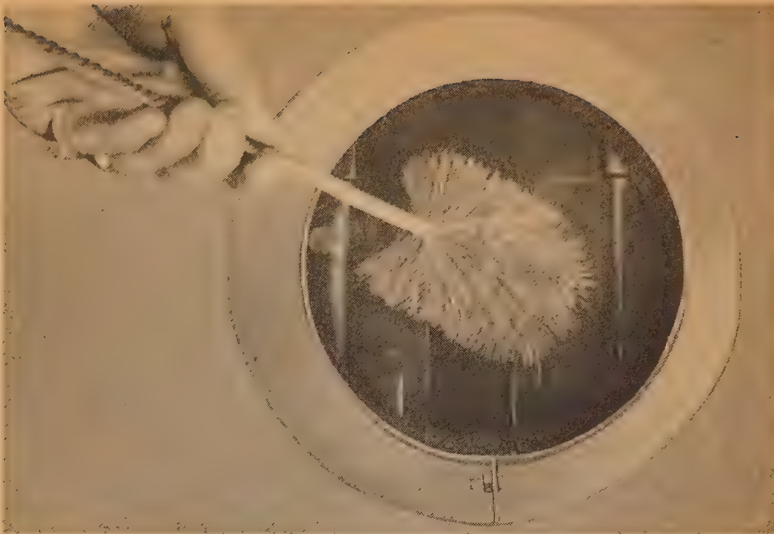


Figure 12.
A wire brush is used to detach sooty deposits from the furnace walls.

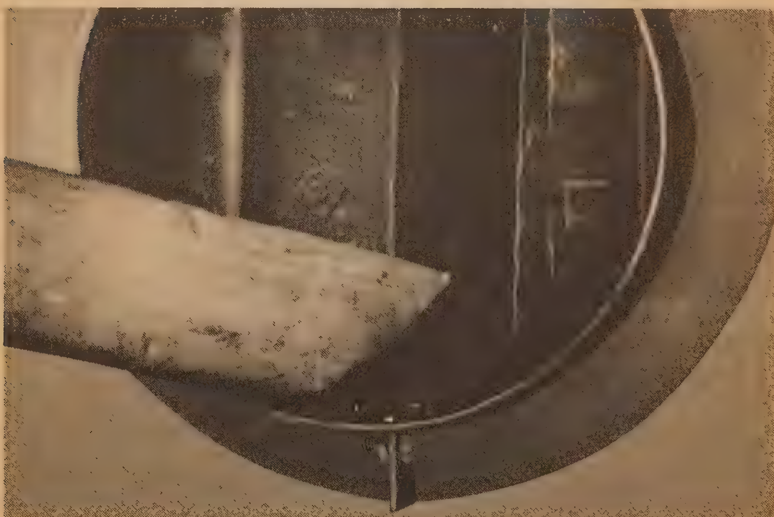


Figure 13.
A vacuum cleaner can be inserted through the same access point . . .

Figure 14.
. . . and used to remove the detached deposits.

Figures 12, 13 and 14 show the cleaning operation. Alternative or additional access is sometimes provided through an inspection door above the burner. Here, the service mechanic must be careful that he doesn't damage the combustion chamber while cleaning.

There are products on the market which claim to destroy soot deposits by igniting them. Several furnace manufacturers warn that such products should not be used in their furnaces. These "magic" compounds are not recommended. A good serviceman is a better alternative.

Step 6: Warm-air circulation

The fan

The air-circulating fan, usually found at the opposite end of the furnace from the burner, may need an overhaul. Access is through a detachable panel at the rear of the furnace (Figure 15).

Figure 15.
Access to the air-circulating fan and air filters is commonly through a panel at the rear of the furnace.

The fan itself will need cleaning about once every three years. If the system operates without filters (by accident or strange design), cleaning should be more frequent. The fan must be removed to clean it properly (Figures 16 and 17) and must be precisely relocated.

Figure 16.
Preparing to remove the air-circulating fan.

Other points: the drive motor may need lubrication. Some fan bearings should be lubricated, others have "permanent" lubrication. Replacing worn bearings will reduce both noise and power requirements.

The alignment condition and tension of the drive-belt should also be checked (Figure 18). A maximum of 1 inch total movement is recommended.

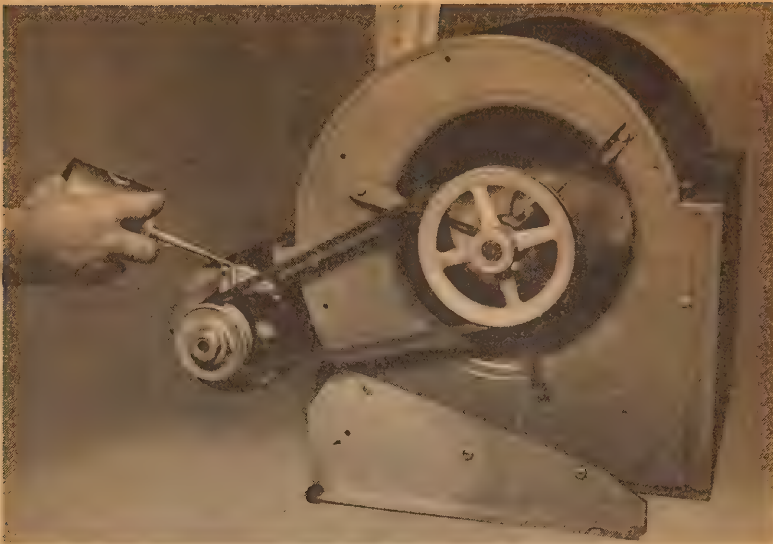


Figure 17.
Lubricating the circulating-fan motor. This can be done without removing the fan from the furnace.

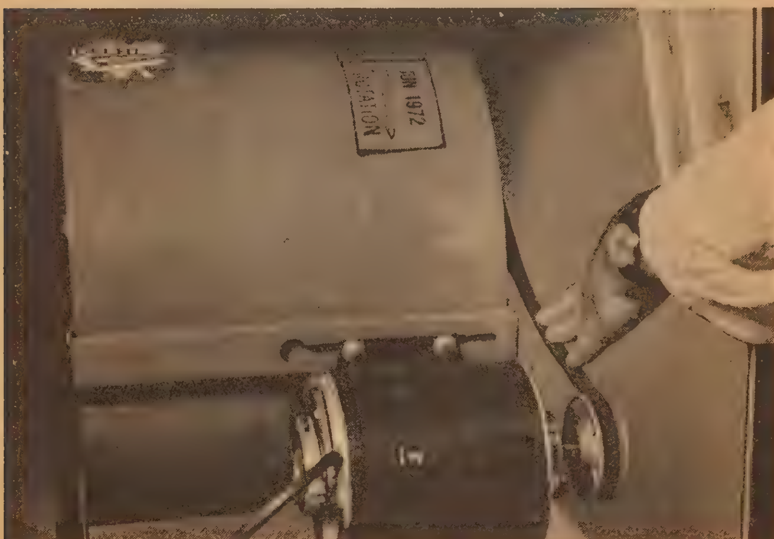


Figure 18.
Checking the tension on the belt drive to the air-circulating fan.

Air filters

Old air filters should be replaced with new ones (Figures 19 and 20). *Be sure to clean or replace filters monthly through the heating season, using filters with an Underwriters Laboratory certification.* A thorough monthly vacuuming will extend normal life to three months. Some "permanent" filters can be washed once a month and re-used for more than one heating season.

Figure 19.
Removing an old, dirty, air filter.

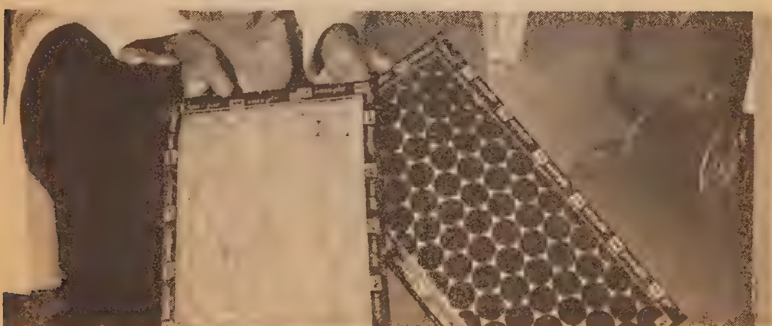


Figure 20.
Dirty filters should be replaced with new ones!

Step 7: Water circulation. In hot-water heating systems the water circulating pump should be inspected for leakage and then lubricated once a year.

When all these furnace-cleaning steps are completed, your serviceman re-assembles the breeching, barometric damper, stack controller and chimney system. He makes sure the damper is vertical with its pivots horizontal and that all joints are firm and leak-proof. Now he's ready to tackle the oil supply and burner.

Stage 3: THE OIL SUPPLY AND BURNER

Step 1: The oil filter. This filter removes any fine particles that may accumulate in the storage tank. It's located in the oil supply line, usually immediately after the stop valve.

The serviceman closes the stop valve, dismantles the filter, cleans the bowl, and, if necessary, replaces the filter cartridge and gasket and then re-installs the filter (Figues 21, 22 and 23), filling the bowl from the tank.

Figure 21.
Cleaning the oil-filter bowl.

Figure 22.
Replacing the oil-filter cartridge.

Figure 23.
Installing a new gasket prior to re-assembling the oil filter.

Step 2: The oil burner. Figures 24 to 27 show a typical oil burner and its parts. The serviceman won't strip it down to the degree shown; this isn't necessary for effective servicing.

Either the burner itself is removed for easier access (Figure 27), or just the oil nozzle and electrode assembly are removed from the burner (Figure 33).

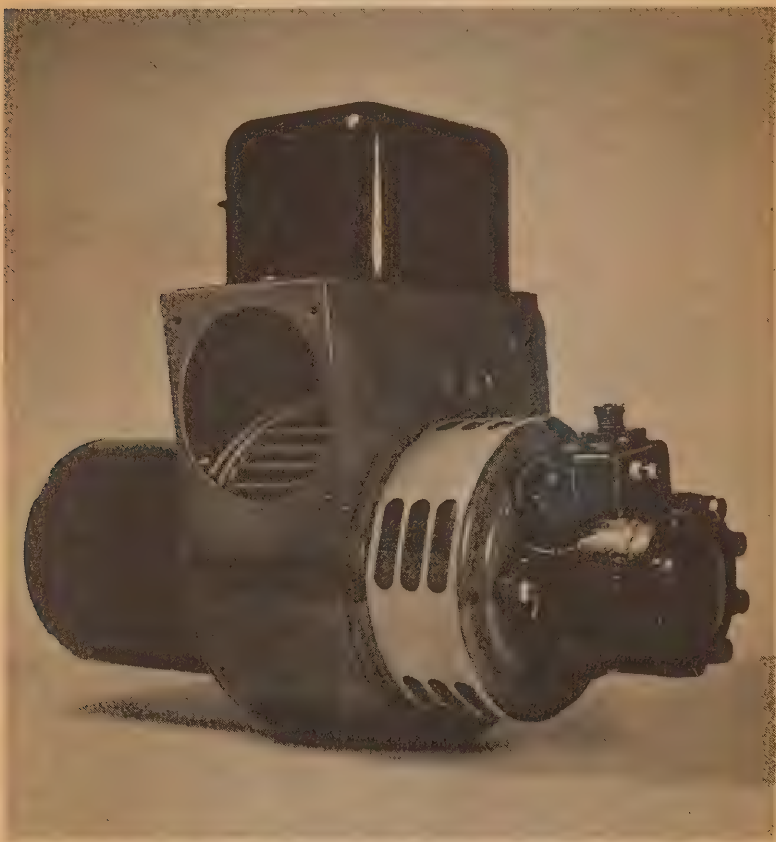


Figure 24.
Parts of an oil burner. The drive motor and oil pump are mounted on opposite sides of the casing; the air adjustment band is adjacent to the pump and the transformer is on the top of the casing. The air fan is just visible through the blast-tube mounting hole.

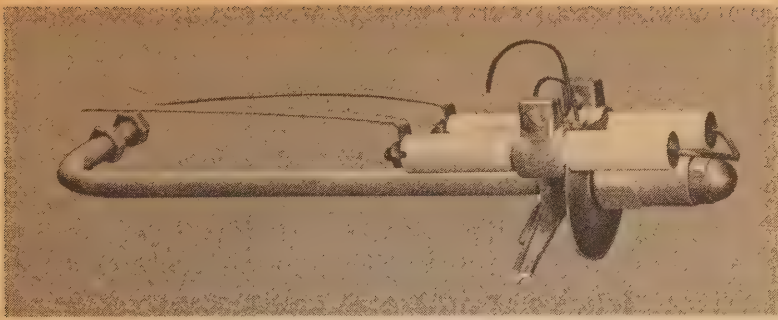


Figure 25.
Parts of an oil burner: the oil line, nozzle and electrode assembly.

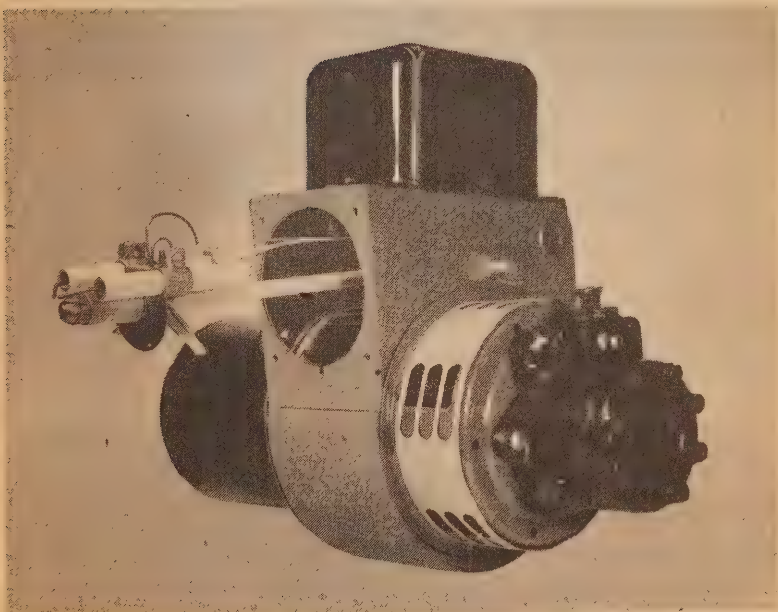


Figure 26.
Parts of an oil burner: the nozzle assembly in position.

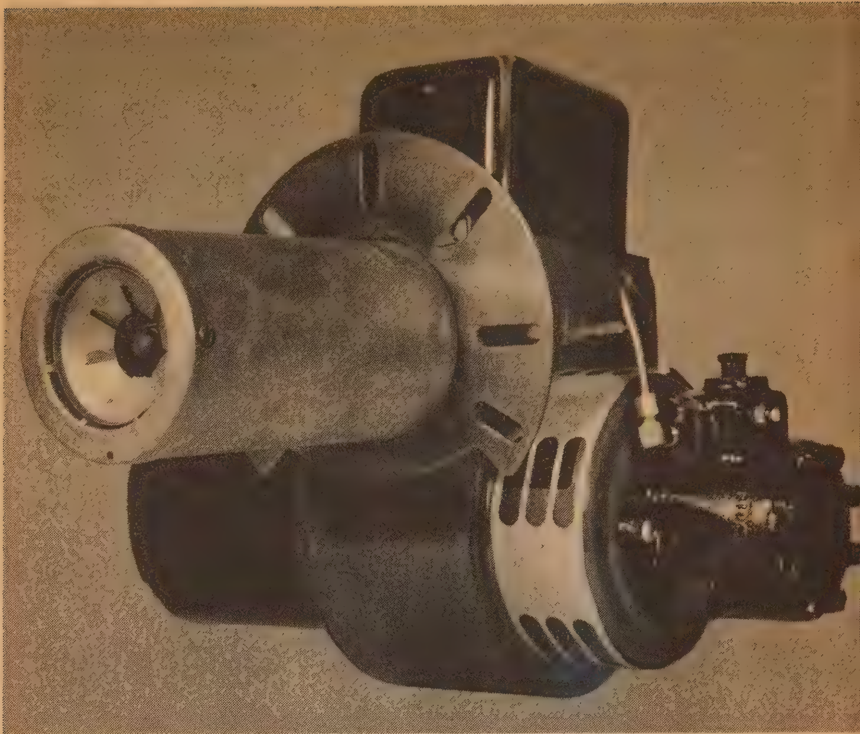


Figure 27.
The assembled burner. The nozzle and electrodes are just visible through the end of the blast tube.

Electric connections. These are all checked to ensure that they are in good condition.

Ignition electrodes. High-tension leads to the electrodes are replaced if deterioration is apparent. The electrodes are insulated with ceramic sheaths (Figure 25) and these *must* be in good condition and clean.

The electrodes themselves should be clean. Any crusty deposits on the tips must be removed and the reason for them tracked down. For example: the location of tips in relation to the oil spray.

Oil nozzle. The oil nozzle is a key to the entire burner system since it is responsible for the condition of the fuel as it enters the combustion chamber. A good nozzle injects fuel into the flame as a fine mist; a poor or dirty nozzle injects larger droplets which are difficult to burn efficiently.

At the first sign of hard deposits or accumulated lacquer, the nozzle should be replaced. Figure 28 shows how an oil nozzle is removed with a special tool. Figure 29 shows a deteriorated nozzle, and the new replacement unit.

Nozzles that carry the certification of the Canadian Standards Association should be used.

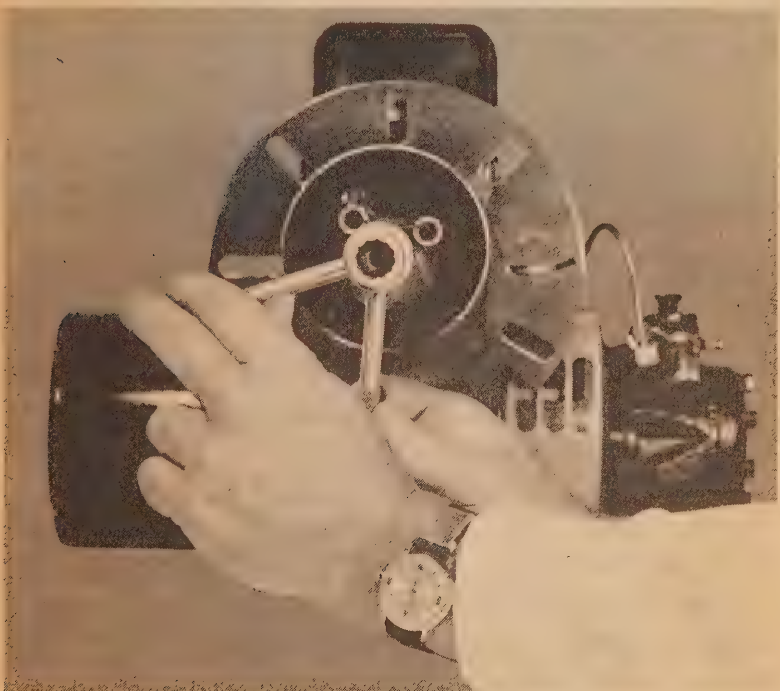


Figure 28.
Removing the oil nozzle with a special tool; in this case the burner has been removed from the furnace.

Figure 29.
A new nozzle and, adjacent, an old nozzle in need of replacement.

Fan, fan-housing and motor. The fan-wheel and fan-housing should be cleaned. Some motors need one drop of SAE 20 lubricating oil.

When these steps have been completed, the service mechanic re-assembles the electrode and nozzle unit, and adjusts the electrode position to the manufacturer's recommendation. Figure 30 shows a typical manufacturer's instruction. (This information is also in the burner service manual.)

The nozzle and electrodes are now in their recommended positions.

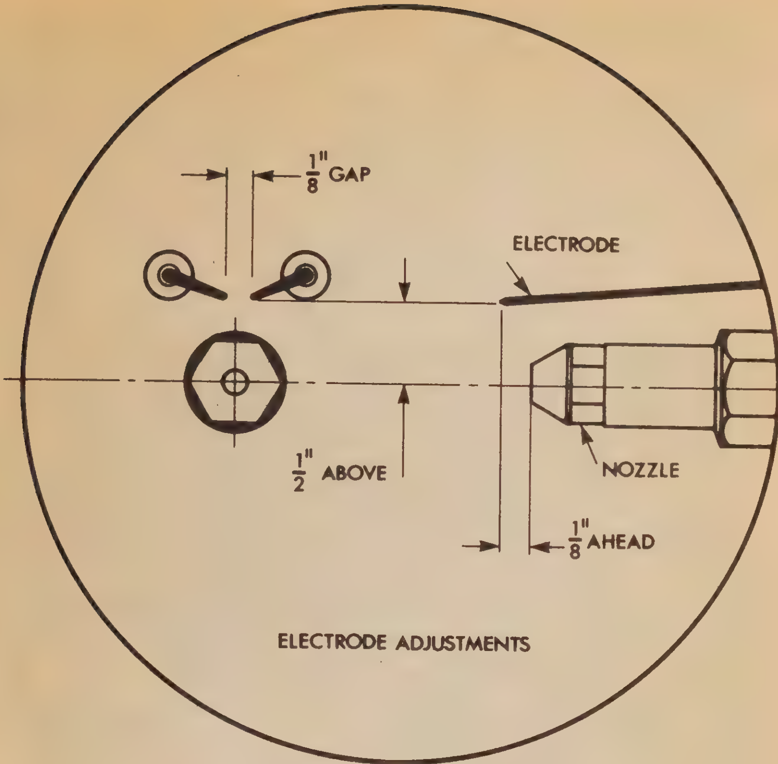


Figure 30.
A typical manufacturer's instruction for electrode and nozzle positioning.

Oil Pump. Air that sneaks into the oil line during the cleaning of the filter must be removed. The amount of air is usually small and can be purged by operating the burner or pumping the oil into a container until air is no longer visible in the special tubing attached to the bleed valve (Figure 31). The oil pressure can then be checked with a pressure gauge (Figure 32) for the recommended level. Usually burners operate at 100 pounds per square inch and remain constant for many years after adjustment.

The pump should be checked for adequate suction and possible oil leaks.

The burner can then be re-installed in the furnace (if it was fully removed) making sure that the asbestos mounting gasket gives an air-tight seal against the furnace casing.

Figure 31.
Purging air from the oil lines.

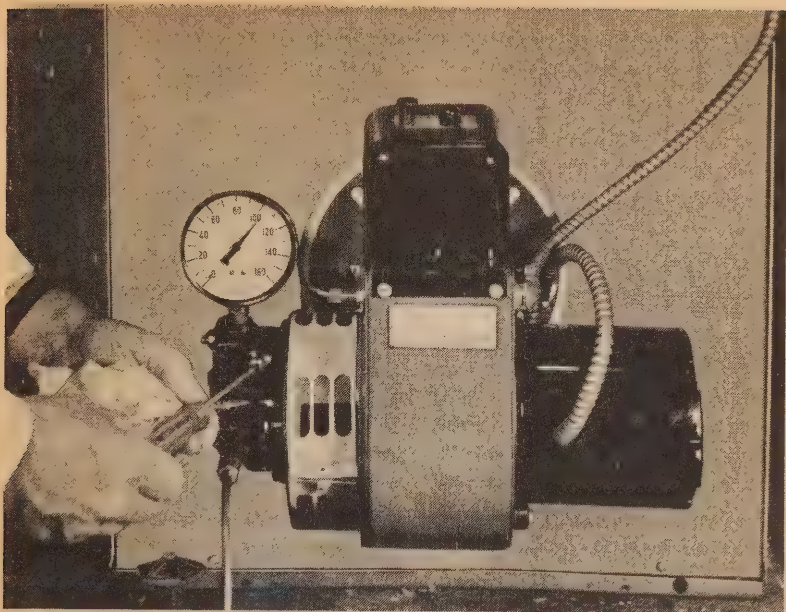


Figure 32.
Adjusting the oil-pump pressure to 100 pounds per square inch.

Safety controls. The safety timing of the primary controller can now be checked. The primary safety control may be either a stack control as in Figures 8 and 9 or, as in most modern units, a photocell as in Figure 33. (The photocell can be mounted in alternative locations). To check the safety timing of these devices—both of which cut off the power supply to the burner if the flame either fails to ignite or is extinguished during operation—servicemen use different techniques. Stack controllers will not permit burner operation for more than 120 seconds without a flame; modern photocell systems will not permit burner operation for more than 45 seconds without a flame.

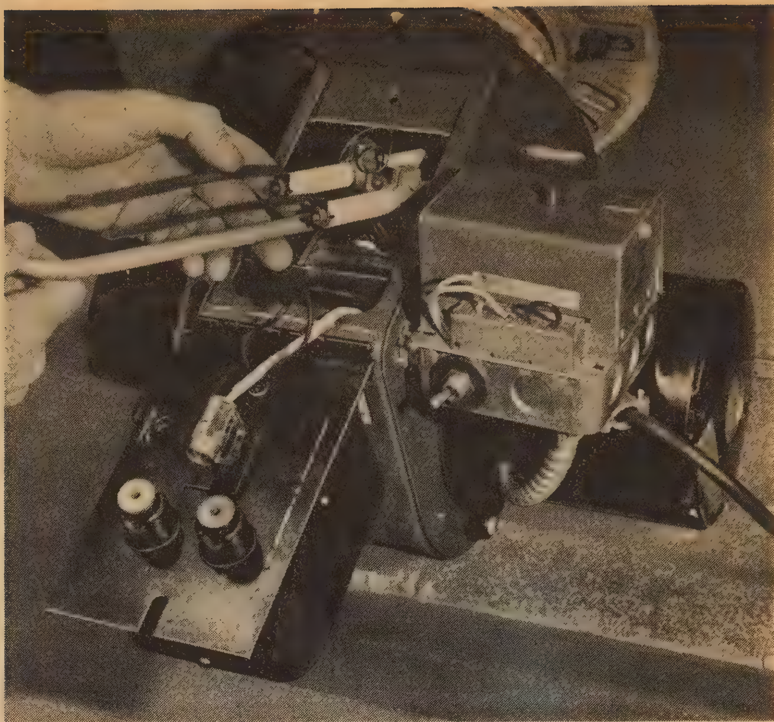


Figure 33.
The oil nozzle can be removed with the burner left in position. In this illustration a photocell is shown on the underside of the transformer above the two electrode "button" connections.

Stage 4: BURNER ADJUSTMENTS

The service mechanic carries a *test kit* with four pieces of equipment. They measure the smoke number, flue-gas temperature, carbon dioxide concentration in flue gases, and furnace draft. Each of these factors affects the safety and efficiency of the furnace after the annual or semi-annual servicing.

The Bacharach smoke meter. This measures the amount of soot generated by the flame. The probe attached to a hand-operated pump (Figure 34) is inserted through a small ¼-inch hole in the exhaust breeching between the furnace and barometric damper. A small volume of combustion products is withdrawn, as in Figure 35, by ten slow strokes and passed through a filter paper. The blackness of the stain on the paper is compared with a standard chart and reported as the smoke number on a scale of 0 to 9.

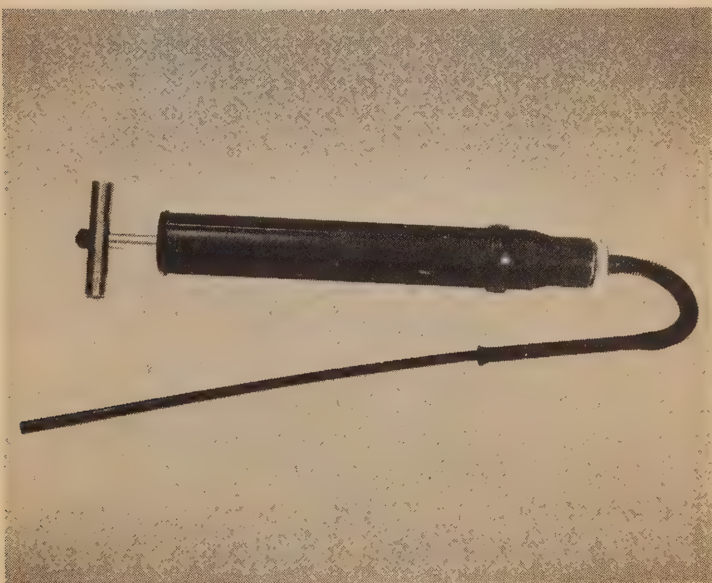


Figure 34.
The Bacharach smoke meter.

Figure 35.
The service mechanic taking a smoke spot sample with the Bacharach smoke meter.

The flue-gas temperature indicator is a dial thermometer (Figure 36), much like a meat thermometer, and operates over a temperature range of 200 to 1000°F (95 to 535°C). It is inserted (Figure 37) into the flue gases through the same ¼-inch hole used for smoke measurements. The temperature is taken after the burner and circulating fan have been running for 10 minutes.

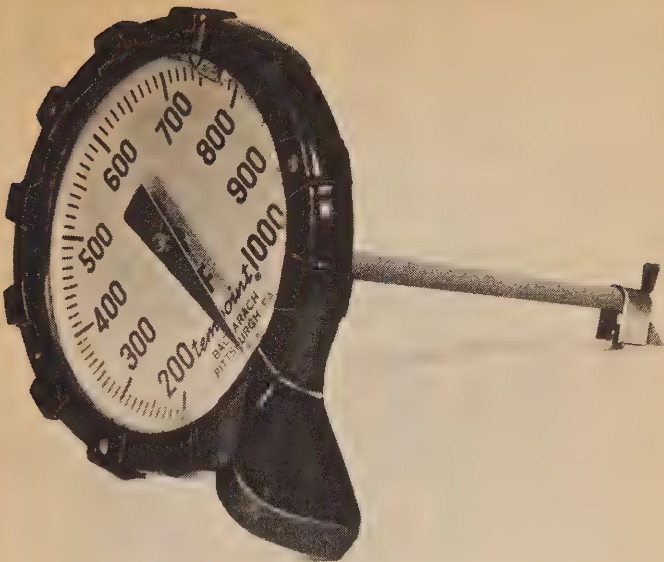


Figure 36.
The flue-gas temperature indicator.

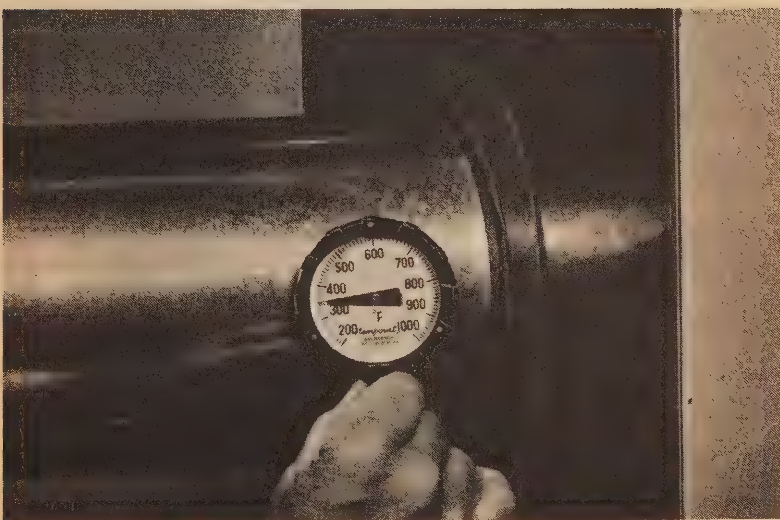


Figure 37.
Measuring the flue-gas temperature.

The carbon dioxide analyzer (Figure 38) measures the amount of carbon dioxide in the flue gases. Carbon dioxide is a gas produced during combustion. Low readings indicate inefficient combustion. The same ¼-inch hole is used to withdraw a gas sample from the breeching (Figure 39).

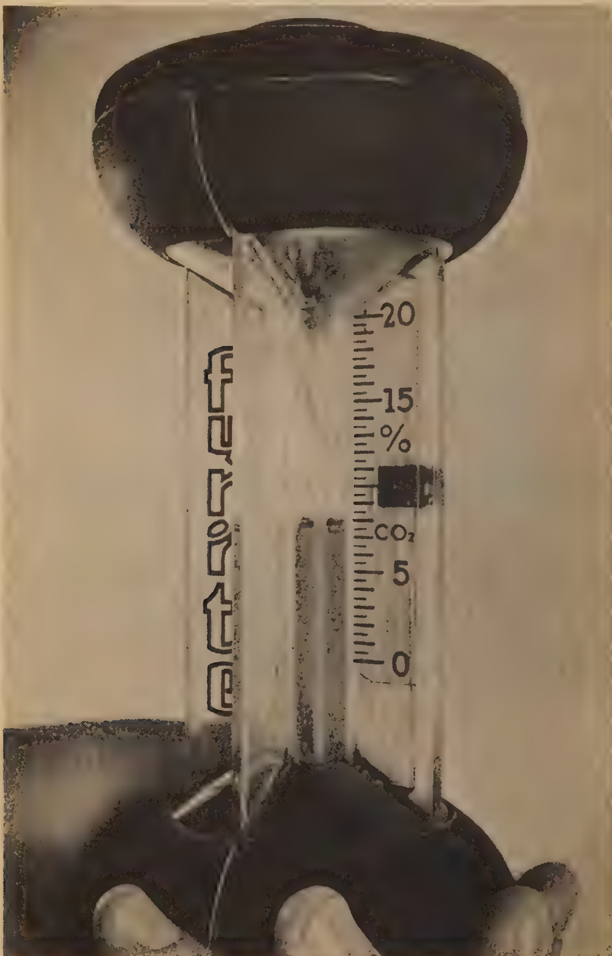


Figure 38.
The carbon dioxide analyzer.

Figure 39.
The service mechanic taking a sample of the flue gases to measure carbon dioxide.

The draft gauge (Figure 40) is used to measure the draft or air buoyancy at the furnace exit after 5 minutes of furnace operation, using the same ¼-inch sampling hole. The draft requirement of the furnace is spelled out in the manufacturer's manual. Generally an increased draft will lead to excessive heat loss up the chimney; a decreased draft will lead to soot formation in the furnace.

Figure 40.
The draft gauge.

Three Steps to Adjusting the Burner

Step 1: Achieving a low soot flame. A low smoke flame will minimize soot formation and furnace deposits. The accepted standards for oil-burning equipment recommend a smoke number of 2 at the maximum. Most residential equipment can achieve a smoke number of 0 or 1.

The service mechanic switches on the heating system and adjusts the air shutter (Figure 41) to produce a flame that is visually free from smoke. Then he measures the smoke number with the Bacharach smoke meter.

If the number is 0, he will alternate his measurements of smoke with continued reductions in air supply to the flame (by closing the air band openings) until a smoke number of 1 is achieved. By opening the air shutter just a little, the smoke number will then be 0.

If the first measured smoke number is not 0, the air supply should be increased until 0 is just achieved.

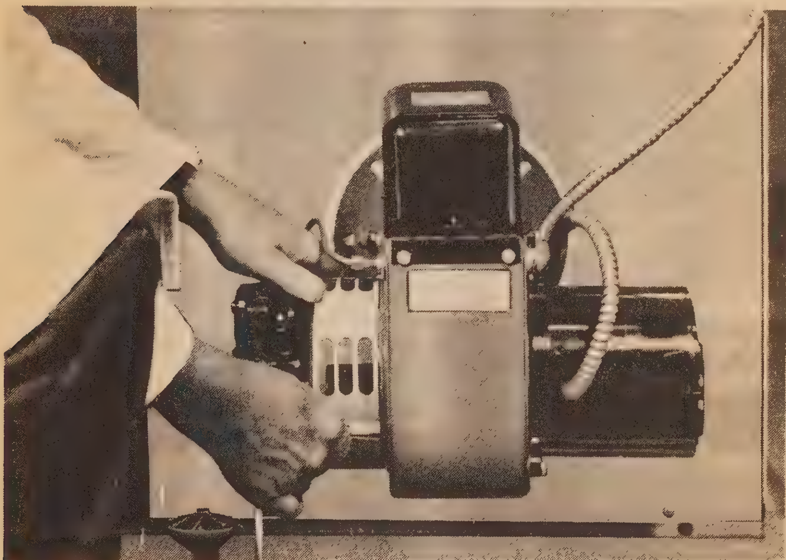


Figure 41.
Adjusting the air band setting.

Step 2: Adjusting the furnace draft condition. The furnace draft should be set to the manufacturer's specifications by adjusting the barometric damper. The smoke number should be re-checked after this to ensure that it has not changed. If necessary, the air shutter should be readjusted.

An experienced serviceman makes sure that his adjustments have not created a pressure in the furnace. So this can't happen, most manufacturers specify the draft at the outlet from the furnace.

Step 3: Determining the furnace's efficiency. To carry out this final step in the tune-up the serviceman will take two measurements:

— the flue-gas temperature (in degrees Fahrenheit or Celsius).

— the carbon dioxide concentration (in per cent).

You should be present at this time and write these numbers down on the spaces provided in the checklist.

A high flue-gas temperature, above 500°F (260°C) indicates average heat-exchange performance (too much heat up the chimney) that could be improved; above 550°F indicates poor heat-exchange performance that should be improved. A flue-gas temperature above 600°F probably means that the furnace is overfired and that the nozzle size should be reduced. See Chapter 3 on opportunities for improved efficiency.

A low carbon dioxide reading, less than 9 per cent, indicates poor burner performance or an old inefficient burner.

By combining these numbers you can calculate your furnace's overall heating efficiency using either Method A or Method B.

Method A — Sliding Calculator (found at the back of this book).

Match up your flue-gas temperature with the arrow marker. Your overall furnace efficiency appears opposite your measured carbon dioxide concentration.

Method B — A more detailed method using Figure 42.

Move upwards from your carbon dioxide measurement until you reach the level of your flue-gas temperature measurement. This is your furnace performance point. The sloping lines will indicate your

approximate overall efficiency. The box number in which your point falls, together with the Key to Figure 42 will allow you to trace the source of low overall efficiency to either poor burner performance, poor furnace performance or both.

All furnaces certified within the last fifteen years are capable of operating at efficiencies above 75 per cent.

If you are not satisfied with the furnace efficiency ask the service mechanic to re-tune the burner or to investigate the opportunities for increased efficiency described in Chapter 3.

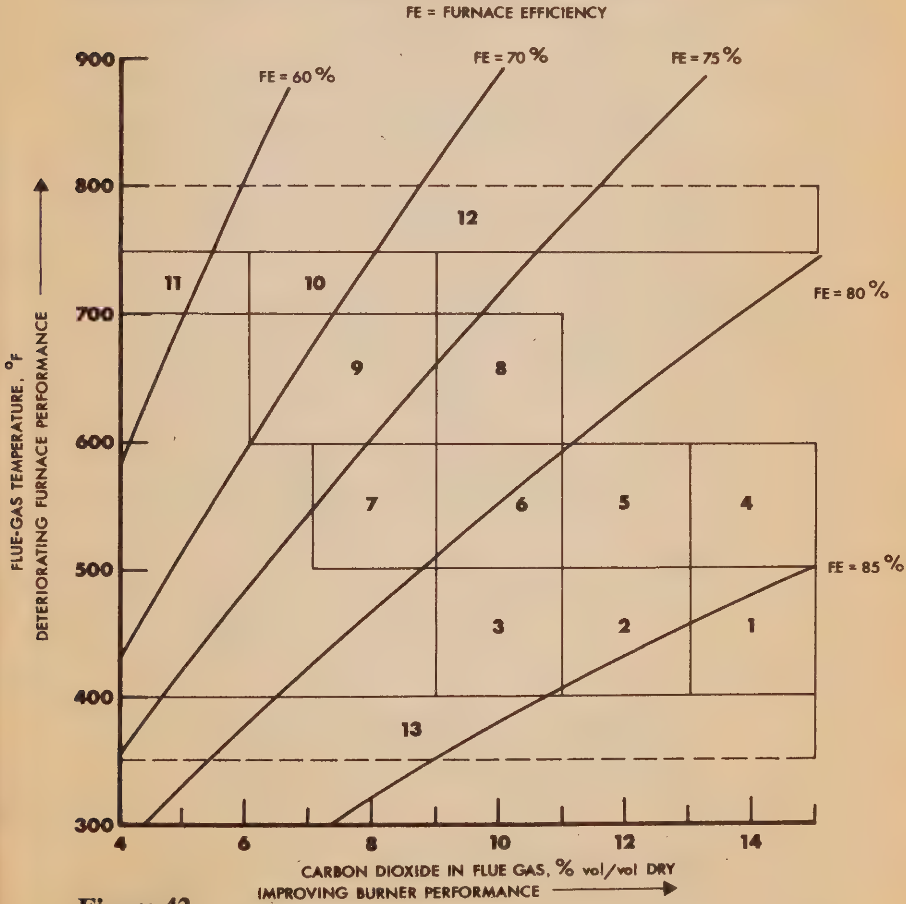


Figure 42

Key to Figure 42

Zone Number	*Quality of Performance* *Furnace*	*Burner*	*Efficiency Range (per cent)*
1	Excellent	Excellent	90 - 83
2	Excellent	Good	87 - 82
3	Excellent	Typical	85 - 80
4	Typical	Excellent	85 - 82
5	Typical	Good	84 - 80
6	Typical	Typical	82 - 76
7	Typical	Poor	80 - 72
8	Poor	Typical	80 - 74
9	Poor	Poor	76 - 65
10	Bad	Poor	74 - 61
11	Bad	Bad	Below 61
12	Completely unacceptable. Flue-gas temperatures above 750°F constitute a materials problem and a fire hazard.		
13	Completely unacceptable. Flue-gas temperatures below 400°F can constitute a corrosion hazard.		

Commentary
Rarely, if ever achieved.
Uncommon; only achieved by the best of new (less than 5-year-old) equipment.
Common to new (less than 5-year-old) equipment, retention head burners.
Rare.
Uncommon, except in good retention head burners.
Common to new (less than 5-year-old) equipment, retention head burners.
Unfortunately common in new equipment where it is evidence of a poor burner; in old equipment (more than 5 years old) (with standard head burners) this is a good performance.
Common; in new equipment it is evidence of poor heat-exchanger design or overfiring.
Common in old systems where again it may be evidence of overfiring or inadequate heat-exchanger design.
Both categories are uncommon except in the oldest of systems. This performance is very poor.
Unsafe operation from the point of view of fire hazard.
Unsafe operation from the point of view of the structural stability of the chimney.

Stage 5: THE FINAL INSPECTION

Once all the tune-up steps and operational changes have been completed, the service mechanic will be able to report the carbon dioxide level, the flue-gas temperature, the smoke number and draft condition to the company record file and to the billpayer.

Below is a complete oil-furnace checklist for summer or mid-winter servicing. It should be kept handy, either in this book or near the furnace so that the serviceman can fill it out completely after each visit, adding his signature and the date.

The operations listed in the checklist form a total overhaul of an oil-fired system. A well-maintained system may not need every one of these checks every year. When you have a good serviceman trust his judgement, he may omit the operations marked with an asterisk on alternate visits.

The final step is to make sure that all external casing, inspection ports and access panels are in position and air-tight. Air leaking into the furnace is unnecessary and inefficient.

The furnace casing and work area should be cleaned up. Waste oil collected during the pump priming should be dumped into the waste tank in the service truck.

Now the unit is ready to do its job efficiently.

This complete overhaul of an oil furnace should take about 2 hours.

Water heaters

If you have an oil-fired water heater, ask the service mechanic to undertake similar cleaning and tuning on it as well.

Oil-Fired Systems / Service Check List

	SUMMER 77	MID-WINTER 77/78	SUMMER 78	MID-WINTER 78/79	SUMMER 79	MID-WINTER 79/80
Stage 1 VISUAL CHECKS						
Step 1 Filling and vent pipes						
Step 2 Fuel-level indicator						
Step 3 Oil lines: check for leakage ..						
Step 4 Exhaust breeching condition .						
Step 5 Furnace casing						
Step 6 Warm-air ductwork						
Step 7 Hot-water pipes						
Step 8 Preliminary furnace operation						
a) Burner operation						
b) Flame condition						
c) Combustion chamber condition						

Oil-Fired Systems: Service Check List

	SUMMER 77	MID-WINTER 77/78	SUMMER 78	MID-WINTER 78/79	SUMMER 79	MID-WINTER 79/80
Stage 2 FURNACE OVERHAUL						
Step 1						
Exhaust breeching clean-out						
Step 2 Barometric damper						
a) Clean-out						
b) Re-set correctly						
c) Clean and lubricate pivots						
Step 3 Stack controller						
a) Clean-out						
b) Re-set						
Step 4						
Chimney base clean-out						
Step 5						
Furnace internal surfaces						
a) Clean-out (wire brush) ..						
b) Remove loose soot with vacuum cleaner ...						
Step 6 Warm-air circulation						
a) Check fan; clean, lubricate and align if necessary*............						
b) Replace air filters						
Step 7						
Warm-water circulation						
Inspect and lubricate water circulation pump ...						

Oil-Fired Systems: Service Check List

	SUMMER 77	MID-WINTER 77/78	SUMMER 78	MID-WINTER 78/79	SUMMER 79	MID-WINTER 79/80
Stage 3 THE OIL SUPPLY AND BURNER						
Step 1 Oil filter*						
a) Remove filter and replace						
b) Clean filter bowl						
c) Replace gaskets						
Step 2 Oil burner						
a) Check electrical connections						
b) Ignition electrodes: check, clean and re-set. .						
c) Oil nozzle: check and replace where necessary .						
d) Fan, fan housing and motor: clean and lubricate						
e) Oil pump: purge oil line, check and re-set pressure*...............						
f) Safety controls: check and replace if necessary .						

Oil-Fired Systems: Service Check List

	SUMMER 77	MID-WINTER 77/78	SUMMER 78	MID-WINTER 78/79	SUMMER 79	MID-WINTER 79/80
Stage 4 BURNER ADJUSTMENTS						
Step 1						
Adjust air intake to give low smoke number						
(0 to 1 on Bacharach smoke meter)						
Step 2						
Adjust draft condition (using barometric damper and draft gauge)						
Step 3						
Determine efficiency:						
Flue-gas temperature						
Carbon dioxide content . . .						
Furnace efficiency						
Stage 5 THE FINAL INSPECTION						
Clean all external surfaces; ensure all doors and panels are air-tight; remove all waste material						

Oil-Fired Systems: Service Check List

SUMMER 77	Name	Date	Company
MID-WINTER 77/78	Name	Date	Company
SUMMER 78	Name	Date	Company
MID-WINTER 78/79	Name	Date	Company
SUMMER 79	Name	Date	Company
MID-WINTER 79/80	Name	Date	Company

2, gas-fired heating systems

The components of a gas-fired system differ from those of an oil-fired system (Figure 43).

In urban centres, where gas is supplied by an underground distribution system, there are no fuel storage tanks. In other areas, where propane is used, the supply cylinders (often called bottles) are usually outside the home.

In a natural-gas system the gas flows through a meter and is piped directly into the heating unit. Inside the unit is an automatic valve which is controlled by your wall thermostat. This valve acts as a safety shut-off in the event the pilot light goes out or if your unit overheats. The valve also contains a regulator which maintains an even gas pressure to the orifice. Here the gas mixes with the proper quantity of air and flows to the burner where it is ignited by the pilot light.

The heat generated from the flame heats the metal surface of the heat exchanger which transfers the heat to the circulating air or water in the home-heating system. While this is going on the products of combustion are removed from the home through the vent pipe and chimney.

An annual overhaul of gas or propane heating equipment is sometimes not considered essential. This equipment does not rely on mechanical fans or pumps to feed fuel and air into the furnace, and because of the clean burning characteristics there is less chance of any carbon build-up on the heat exchanger.

An annual inspection, however, by a service mechanic is recommended to establish the operating standard of the equipment.

Despite the differences between oil and gas, maintenance of the equipment has the same objectives: *to achieve safe, efficient performance.*

If the homeowner detects any leaks of gas, he should contact the gas utility immediately.

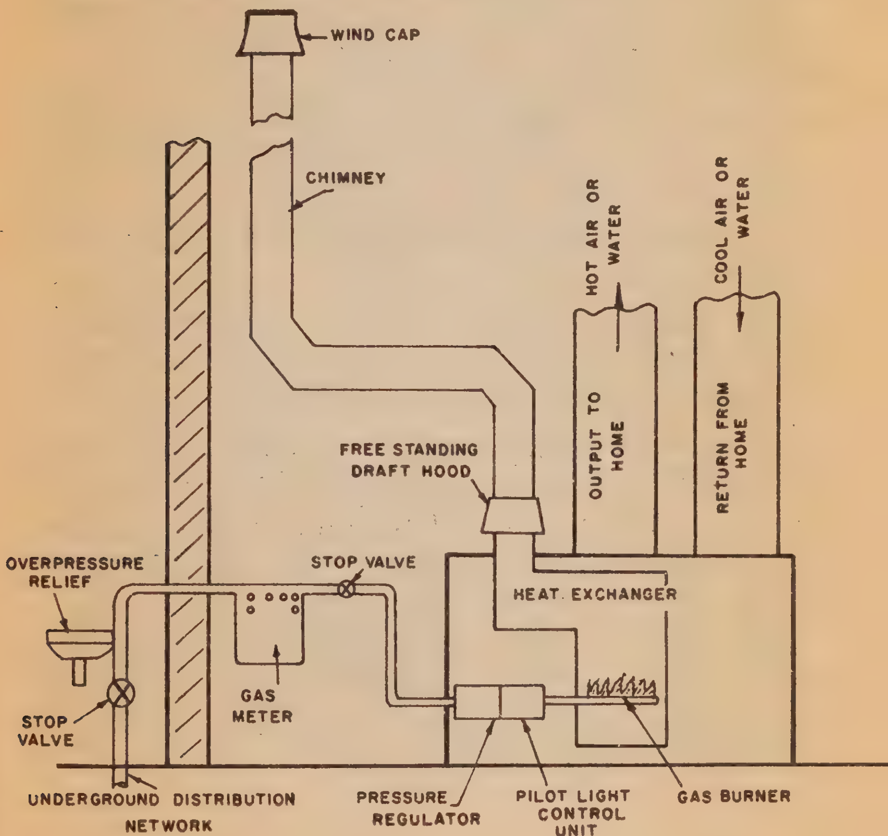


Figure 43.

Schematic illustration of the components of a gas-fired heating system.

THE ANNUAL OVERHAUL

Stage 1: THREE VISUAL CHECKS

Step 1: Vent connection

The vent connector will be examined for condition and replaced where necessary (see for example Figures 2 and 3).

Step 2: Draft hood

The draft hood is a safety device that serves three purposes:

- it assures the ready escape of combustion products from the unit in the event of any restriction in the chimney;
- it prevents back draft from entering the combustion chamber; and
- it maintains the efficiency of the unit by eliminating the effects of stack action just as the barometric damper does in the case of oil furnaces.

In some cases, particularly older units and furnaces that have been converted to gas from oil or coal, the draft hood will be free-standing as in Figure 44. In more modern gas-fired equipment, the draft hood may be "built in" to the unit as in Figure 45.

The draft hood will be inspected to ensure that the relief opening has not accidentally been blocked. The area of the relief opening must be kept free of stored household goods at all times.

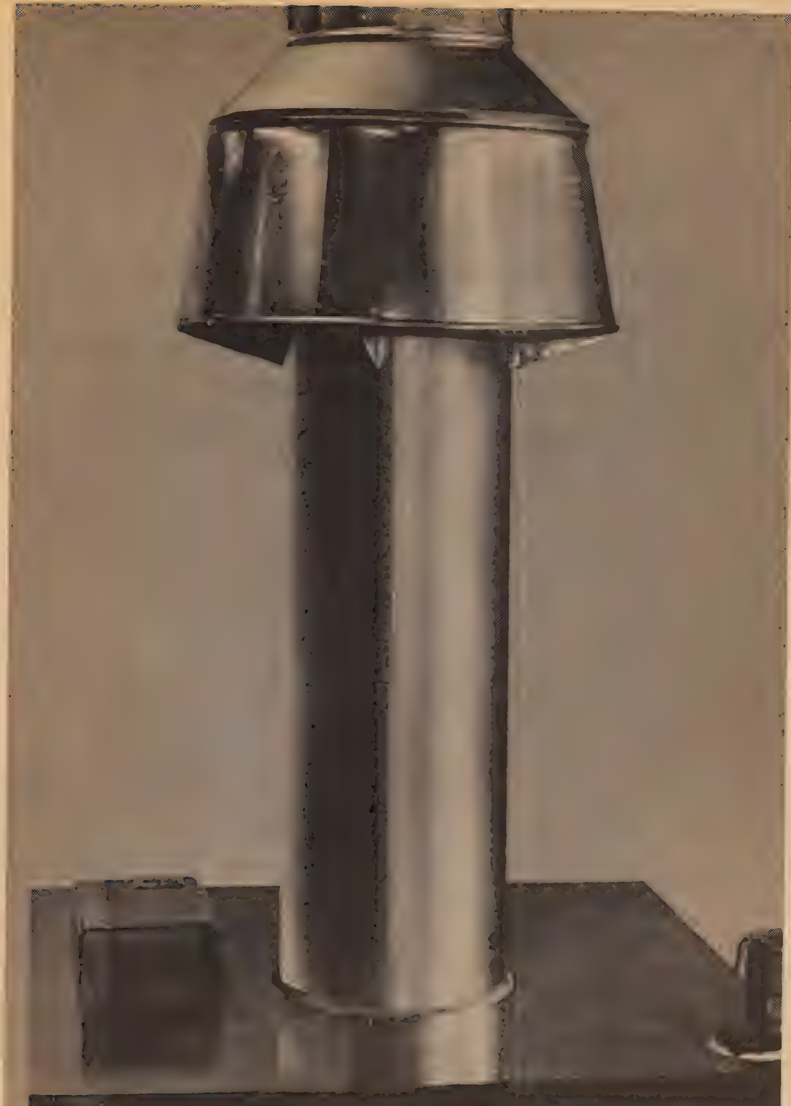


Figure 44.
A free-standing draft hood.

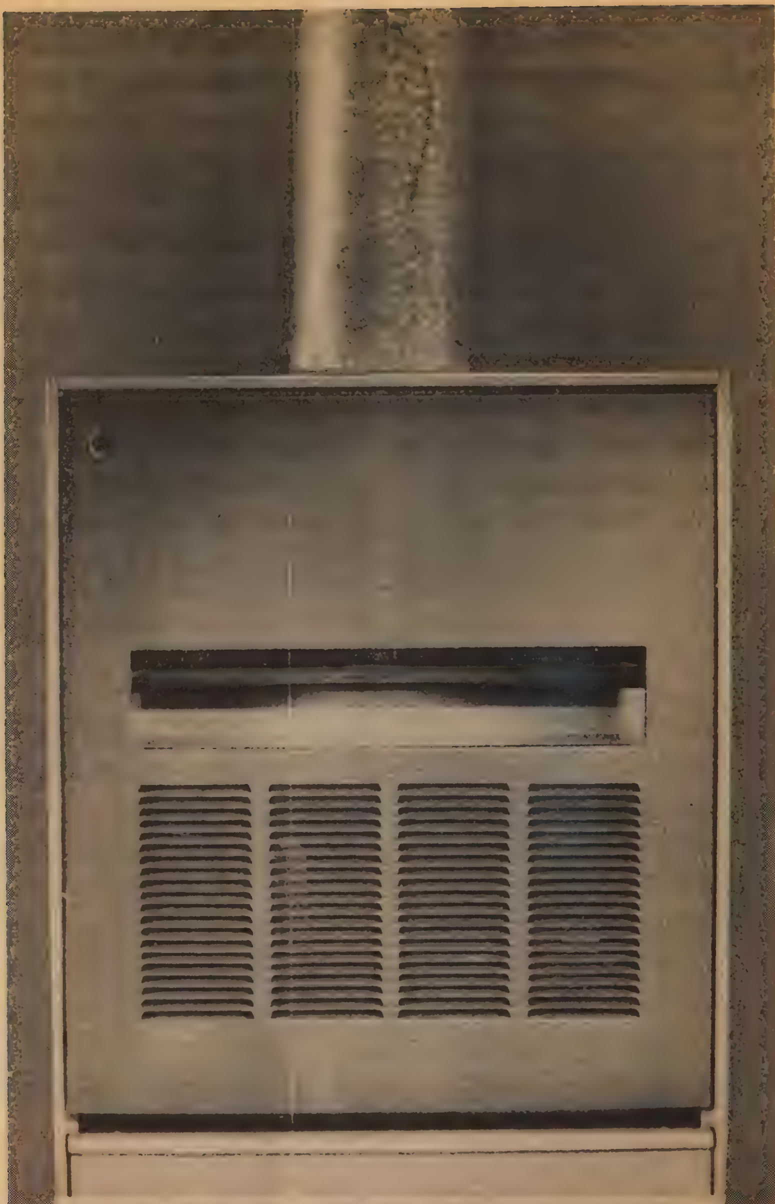


Figure 45.
A built-in draft hood. All that is visible is the dilution-air entry.

Step 3: Chimney base clean-out

A metal plate located below the vent connector where it enters the vertical chimney will be removed and the chimney inspected for any accumulated debris. Homes with factory-fabricated metal chimneys may not need this inspection.

Stage 2: OPERATION OF THE BURNER

Step 1: The pilot light

Gas-fired heating systems use a small, always-burning pilot light (as in Figure 46) to ignite the main burner when the room thermostat calls for heat. This light may be put out accidentally in which case the safety systems

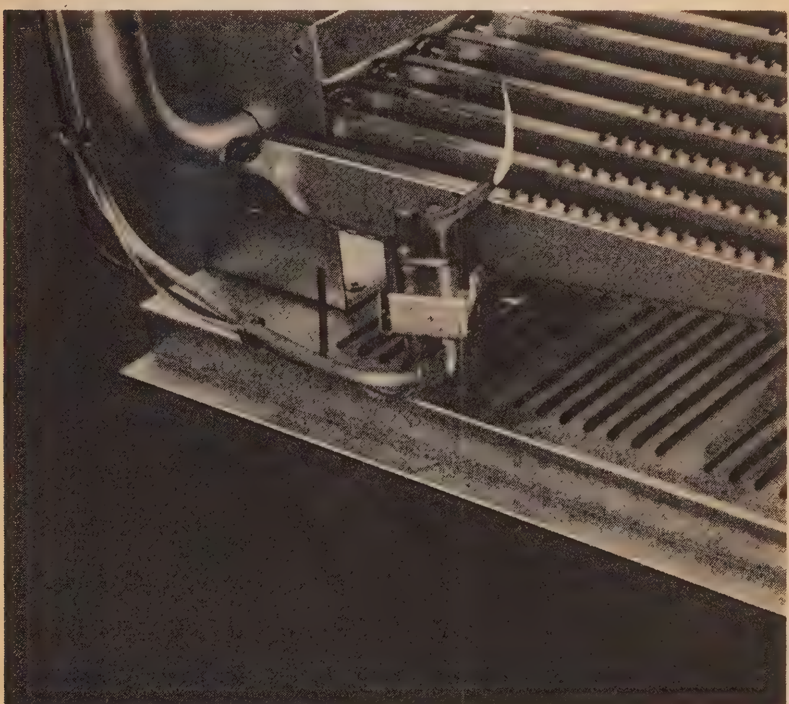


Figure 46.
A typical pilot-light assembly.

will cut off the main gas supply. If this has happened, and the pilot light has been relit by the homeowner (following exactly the instructions printed on the plate attached to the furnace), the service mechanic should be informed. The furnace mechanic will inspect the pilot light and remove any dust or lint and examine the thermocouple (flame sensor) to ensure it is operating properly.

Step 2: Flame inspection

You can usually view the main burner flame through the air vents on the bottom of the furnace (see Figure 47). To do this a protective grill must be removed. The flame is made up of many small, blue cones which should be uniform in shape and size. It should look clean, with no permanent yellow showing. Note, however, that dust particles in the air can cause temporary yellow flecking in the flame; this does not mean that the burner needs adjustment. The service mechanic will view the flame to determine whether cleaning of the burner is necessary and if the combustion air controls need adjustment.

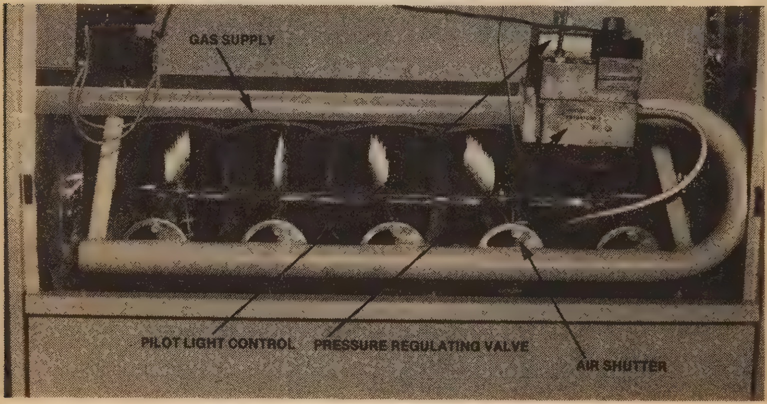


Figure 47.
The main flame.

Step 3: Cleaning the burner

In cases where the burner tips have become blocked or restricted, the serviceman will shut off the gas supply at the main valve and clean the burner tips with a soft brush.

Step 4: Adjusting the flame

If the flame inspection shows it to be necessary, the service mechanic will adjust the flame condition by opening the air shutters until the flame "lifts off" the burner. He will then progressively close the air shutters until a clean blue flame "anchors" onto the burner tips.

Step 5: Furnace air grill

The air shutters are behind a protective grill which also covers the pressure regulator and pilot control switch. This grill was removed to carry out the flame inspection. It should be cleaned.

Stage 3: FURNACE OVERHAUL

Step 1: Heat-exchanger inspection

When viewing the flames, the service mechanic will observe the surfaces of the heat exchanger, looking for corrosion or cracks. For this inspection the serviceman may use a mirror and flashlight. In rare cases, through improper setting of the air shutter or by blockage of the combustion air opening by dust, the flame may have created a soot deposit, in which case the heat exchanger will require cleaning.

Step 2: Cleaning (where necessary)

When cleaning is required, the service mechanic will probably use a wire brush and vacuum cleaner. A few gas utilities approve the use of a chemical cleaner.

There are no instances where the billpayer can perform either a mechanical or chemical cleaning operation himself.

Step 3: Warm-air circulation

The fan

The air-circulating fan, usually found at the opposite end of the furnace from the burner, may need an overhaul. Access is through a detachable panel at the rear of the furnace (Figure 15).

The fan itself will need cleaning about once every three years. If the system operates without filters (by accident or strange design), cleaning should be more frequent. The fan must be removed to clean it properly (Figures 16 and 17).

Other points: the drive motor may need lubrication; some fan bearings should be lightly oiled, others have "permanent" lubrication. Replacing worn bearings will reduce both noise and power requirements.

The alignment and tension of the drive-belt should also be checked (Figure 18). A maximum of ½-inch total movement is recommended.

Air filters

Old air filters should be replaced with new ones (Figures 19 and 20). *Be sure to clean or replace filters monthly through the heating season. This is something the billpayer can do himself.* A thorough monthly vacuuming will extend normal life to three months. Some "permanent" filters can be washed once a month and re-used for more than one heating season.

Step 4: Water circulation

In hot-water heating systems the water-circulating pump should be inspected for leakage and then lubricated once a year.

Stage 4: COMBUSTION CONDITIONS

Step 1: Combustion products

Carbon monoxide (a colourless, odourless poisonous gas) indicates an inefficient and dangerous burner adjustment. If the serviceman suspects (from the appearance of the flame or the presence of soot) that the burner is producing carbon monoxide, he will request his supervisor to arrange for this to be measured. This is a specialized operation but will be carried out immediately by the gas utility.

Step 2: Furnace efficiency

Where measurement is not possible

Modern designs of gas furnaces have "built in" draft hoods, as in Figure 45, which do not allow access to undiluted combustion products in the same way that oil furnaces do. In these appliances it is difficult to get an absolute measurement of furnace efficiency; relative measurements are possible (see Chapter 5).

In appliances of this sort, which are of relatively recent design, the appliance must have achieved a minimum efficiency of 75 per cent during testing by the Canadian Standards Association. This testing occurs prior to the model being sold to the public.

Where measurements are possible

In gas-fired appliances equipped with free-standing draft hoods, as illustrated in Figure 44, it is possible to determine overall efficiency. By using the flue-gas tem-

perature indicator (Figures 36 and 37) and the carbon dioxide analyzer (Figures 38 and 39), the serviceman will take the following two measurements through a small (¾-inch) hole in the section of vent pipe between the furnace and the draft hood:

—the flue-gas temperature (in degrees Fahrenheit or Celsius)

—the carbon dioxide concentration (in per cent).

You should be present at this time and write these numbers down on the spaces provided in the checklist.

By combining these numbers you can calculate your furnace's overall heating efficiency using either Method A or Method B.

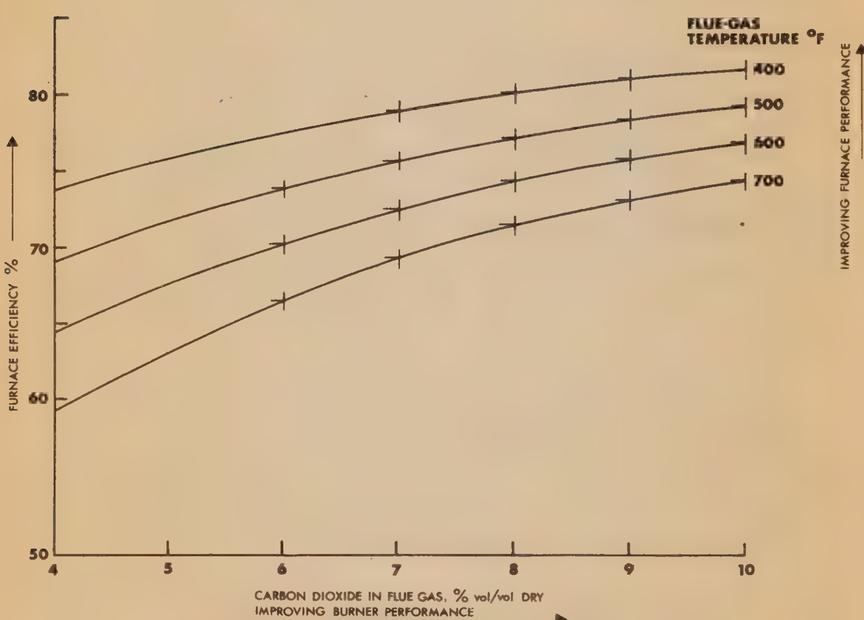


Figure 48.
Efficiency of gas-fired systems.

Method A — Sliding Calculator, Gas Side (found at the back of this book).

Match up your flue-gas temperature with the arrow marker. Your overall furnace efficiency appears opposite your measured carbon dioxide concentration.

Method B — A more detailed method using Figure 48.

Move upwards from your carbon dioxide measurement until you reach the level of your flue-gas measurement. This is your furnace performance point. Move across to the left side to find your overall efficiency.

However you calculate your overall efficiency, it should be greater than 75 per cent. If it is not, this will be due to one or both of the following two factors. Ask your serviceman to investigate both of them.

- **High flue-gas temperature**
  A temperature above 500°F (260°C) indicates poor heat-exchanger performance (too much heat up the chimney). This can be corrected as described in Chapter 3, "Opportunities for Increased Efficiency".
- **Low carbon dioxide reading**
  A carbon dioxide reading less than 6 per cent indicates that the flame condition could be improved by readjusting the air shutters (Stage 2, Step 4).

Stage 5: FINAL INSPECTION AND REPORT

After completing the overhaul, the service mechanic will replace all the protective air grills and furnace covers that were removed to give access to the appliance.

If the measurements were possible, he will be able to report the flue-gas temperature and carbon dioxide readings to the company record file and the billpayer.

Below is a complete gas furnace checklist for annual overhaul. It should be kept handy either in this book or near the furnace so that the serviceman can fill it out completely after each visit, adding his signature and the date.

This overhaul should take about 45 minutes. Allow a little longer if the furnace has to be cleaned.

Now the unit is ready to do its job efficiently.

Water heaters

If you have a gas-fired water heater, ask the service mechanic to undertake similar maintenance on it as well.

Summer shutdown

If you live in a new house that has a dry basement and a flue-lined chimney, you can save gas by shutting off the pilot light for the warm summer months. On a yearly basis, the pilot light consumes about 10 per cent of your total gas consumption. If you're in an older home, check with a heating contractor. Summer condensation could cause rust in the furnace or mortar damage in an unlined chimney.

Gas-Fired Systems/Service Check List

	YEAR				
	1977	1978	1979	1980	1981
Stage 1 VISUAL CHECKS					
Step 1 Vent connection (chimney breeching)					
Step 2 Draft hood					
Step 3 Chimney-base clean-out					
Stage 2 OPERATION OF THE BURNER					
Step 1					
Pilot light inspection					
a) Clean pilot jet					
b) Examine thermal sensing element					
Step 2					
Main flame inspection					
Step 3					
Clean the burner . . . . (where necessary)					
Step 4					
Adjust air shutters . . . . (where necessary)					
Step 5					
Clean air grill					

Gas-Fired Systems: Service Check List

	YEAR				
	1977	1978	1979	1980	1981
Stage 3 FURNACE OVERHAUL					
Step 1					
Inspect heat exchanger					
Step 2					
Clean heat exchanger .... (where necessary)					
Step 3					
Warm air circulation					
a) Inspect fan; clean, lubricate and align if necessary					
b) Replace air filters					
Step 4					
Warm water circulation: Inspect and lubricate water circulation pump					

Gas-Fired Systems: Service Check List

Stage 4 COMBUSTION CONDITIONS

	YEAR				
	1977	1978	1979	1980	1981
Step 1					
Combustion products: check for carbon monoxide					
Step 2					
Furnace efficiency:					
Flue-gas temperature					
Carbon dioxide content					
Furnace efficiency					

Gas-Fired Systems: Service Check List

Stage 5 FINAL INSPECTION AND REPORT

YEAR				
1977	1978	1979	1980	1981
Name	Name	Name	Name	Name
Date	Date	Date	Date	Date
Company	Company	Company	Company	Company

3, opportunities for increased efficiency

After he has completed the annual inspection and overhaul, the service mechanic has other ways of improving furnace efficiency.

Most apply to both oil- and gas-fired systems.

Increasing the air-circulating speed

If the measured flue-gas temperature in a *gas*-fired system is above 500°F (260°C), there is an unnecessary heat loss up the chimney.

If the measured flue-gas temperature in an *oil*-fired system is above 500°F (260°C), the service mechanic must then check the temperature at the chimney base. This must be above 400°F (210°C) for external chimneys and above 350°F (180°C) for internal chimneys to avoid corrosion. If the chimney-base temperature is significantly above these levels, there is an unnecessary heat loss up the chimney.

This unnecessary heat loss can be reduced by increasing the speed of the circulating fan.

This action will drop the temperature by driving the air more quickly over the heat exchanger and drawing more heat into the house. The adjustment is made to the variable speed pulley on the circulating fan motor (Figures 49 and 50).

This change should first be discussed with the bill-payer because it means more circulating air at a slightly lower temperature. A change in the circulating-fan speed should make a difference of no more than 10°F (5°C) in the temperature of the air as it reaches the grill, and shouldn't be noticeable in the room.

Figure 49.
The variable speed pulley in the slow-running position.

Figure 50.
The variable speed pulley in the fast-running position.

Increasing the fan's "on" time

The circulating-fan control measures the temperature of the warm air either before it leaves the furnace (if it's mounted on the furnace) or immediately after it leaves the furnace (if it's mounted on the ductwork). This control switches the fan on when the air temperature reaches 150°F (66°C) and off when the temperature drops to a low limit, usually 130°F (54°C).

Both of these temperatures can be adjusted. (A significant heat loss can occur up the chimney both before the fan switches on and after it has cut out.)

To reduce heat loss, the fan settings can be adjusted to a high of 140°F (60°C) and a low of 100°F (40°C). The fan will start circulating the hot air sooner and run longer after the thermostat has cut off the burner.

Changes to the control settings must be made by a service mechanic. The important high-temperature safety control—a primary safeguard against overheating—is often an integral part of the fan control and must not be altered.

Continuous fan operation

In some homes the circulating fan operates continuously to improve air circulation. During periods of infrequent burner operation, notably spring and fall, this may not save energy, since the fan takes electricity to operate which may outweigh the fuel saving.

The advantage, of course, is better circulation and mixing of air throughout the house.

There's usually a small switch on the furnace which will turn the fan on to continuous operation.

A smaller nozzle size (OIL FURNACES ONLY)

If the flue gases enter the chimney at temperatures higher than 600°F (315°C), you are using too much fuel and generating too much heat for the furnace to handle. Try a smaller nozzle size rather than changing the speed of the circulating fan.

This means a new nozzle. They're available in a range of sizes. A change to one or two sizes smaller can save fuel by giving the furnace an amount of heat that it can efficiently distribute to the home.

The smaller replacement nozzle should have the same basic specifications as the original (except for through-put) to maintain the established ignition characteristics. *And the tune-up procedure must be repeated.*

4, add-on devices

“Heat reclaimers”

There are devices on the market which claim to recover large amounts of the heat lost up the chimney in the form of flue gases. They fit onto the exhaust breeching.

For gas-fired systems, these are prohibited by provincial gas installation codes.

For oil-fired systems, they are not useful when flue-gas temperatures are below 600°F (315°C). Use instead a faster circulating fan or smaller nozzle. Even above 600°F (315°C), their usefulness is limited.

If the service mechanic recommends one of these devices, ask him two questions:

- *Does the device have the approval of the Canadian Standards Association?* If not, don’t buy it.
- *Will it extract more heat than the existing chimney breeching?* If not, don’t buy it.

The second question won’t be easy for the mechanic to answer, but you should have some evidence of performance before you spend $50 or $100.

Remember that you may be replacing a straight length of ductwork with an “add-on” device that only slightly improves the heat extraction.

It is always better and safer to take the heat out in the furnace rather than to install a heat exchanger on the chimney breeching.

Clutch couplings and solenoid valves

These devices are only applicable to oil-fired furnaces.

A large proportion of the soot that accumulates on the heat-exchanger surfaces and reduces the furnace efficiency is generated in the first and last few seconds of a burner operating cycle. This soot formation can be minimized by installing one or other of these two devices. They allow the burner air fan to start before the fuel is admitted and also to run-on after the fuel supply has stopped. The savings that these devices produce vary from furnace to furnace; but they help to keep the furnace clean during the heating season and also make a significant reduction in the soot which is put out into the atmosphere.

Ask your service mechanic about one of these devices.

Retention heads or flame holders

Again, these devices only apply to oil-fired furnaces. They fit onto the end of the oil burner; two retention heads and a standard head are illustrated in Figures 51, 52, 53, and one is shown on the burner in Figure 27. They may allow your burner to operate at higher carbon dioxide levels and hence higher efficiencies. If your burner cannot achieve a carbon dioxide level above 7 per cent you should ask your serviceman about one of these "add-on" devices.

Figure 51.
A standard burner head.

Figure 52.
A retention head.

Figure 53.

A retention head. The same head was shown on the assembled burner in Figure 27.

5. self-servicing and furnace monitoring

What service steps can the billpayer carry out himself? First of all, he should *not* attempt to make any changes that will affect either the safety or the reliability of the unit. However he should be aware of how the system is performing, as a first step towards improving it.

OIL-FIRED SYSTEMS

Control systems

Do not attempt to adjust any of the electrical control boxes.

Most control systems have a small button or lever clearly marked *"re-set"*. If, for any reason, the burner fails to ignite when the thermostat is calling for more heat, first check the fuse box and fuel-oil tank. Then press the re-set button — but no more than *twice*.

If the burner still doesn't start, it's possible that the burner motor has overheated and tripped out on its own thermal protection. Prolonged operation of motors under reduced voltage conditions can lead to overheating and failure. All motors have a small thermal overload re-set button which must be pushed to re-establish the internal circuits. If this step doesn't start the burner, call your burner service man.

Burner servicing

The homeowner should *not* undertake any self-servicing on the burner during the heating season. He should, however, follow a few simple guidelines.

The burner must have an adequate supply of air. This is very important. If the furnace is sitting in an open area within a brick or frame home, air infiltration is usually sufficient.

If the house is of unusually high construction or if it has been carefully weatherstripped to reduce heat losses due to drafts, it is possible that the burner (oil or gas) can be "starved" of air. To see if this has happened you should arrange to have all your windows and doors closed when the annual overhaul is carried out. The house should be sealed as tightly as it will be in the coldest winter weather and the burner adjustments made under these conditions. The service mechanic will then tell you if the normal air infiltration is enough for your burner.

If this is not the case, then a permanent opening to the outdoors, close to the burner, may be desirable. It would have a free area of 28 square inches per U.S. gallon per hour fuel input (1 square inch per 5,000 Btu/hr). In homes with a floor area of 1,500 to 2,000 square feet, this means an opening of about 30 square inches (a 6-inch-diameter hole).

If the furnace is in an air-tight confined room, you have two options: either,

- provide two holes, each of 140 square inches per U.S. gallon per hour fuel input (1 square inch per 1,000 Btu/hr) to the *inside* of the home, or
- provide two direct air openings to the *exterior* of the home each with an area of 28 square inches per

U.S. gallon (1 square inch per 5,000 Btu/hr).

It's also important to make sure that dust from other activities — particularly sawdust and lint — don't get into the burner. Keep a clean basement!

The heat-distribution system

Here the billpayer can do much to help himself.

Keep the air registers clean and free of obstruction

Just as the burner requires a free supply of air for combustion, a warm-air furnace requires a free supply of air for heat transfer. All outlet registers and return ducts should be kept free of blockages — furniture, drapes, newspapers, etc.

Keep the air filters clean

Circulating air filters are available at hardware stores, and easily installed. They should be changed once a month during the heating season. The disposable type can be vacuum cleaned every month and replaced every three months; washable filters will last much longer and should be washed monthly.

Here is a handy chart to keep track of your filter changes or cleanings.

Filter Changes

Date		Service Performed (change or cleaning)
October	1977	....
November	1977	....
December	1977	....
January	1978	....
February	1978	....
March	1978	....
April	1978	....
May	1978	....
September	1978	....
October	1978	....
November	1978	....
December	1978	....
January	1979	....
February	1979	....
March	1979	....
April	1979	....
May	1979	....

Look after your circulating fan

The circulating fan can be lubricated every three months. This won't save energy but may avoid a costly replacement. *Warning: Be sure the master power switch to the furnace is off before you start and don't over-lubricate.*

Check your furnace condition

Measure flue-gas temperature

Throughout the heating season after the annual maintenance, the performance of the furnace can be easily checked by the billpayer with a flue-gas temperature gauge (Figure 36). These gauges can be obtained from scientific equipment supply houses or furnace service companies at a cost of about $15. Be sure to get one with a temperature range covering 150 to 750°F (66 to 407°C).

Measurements should be taken once every week at the location where the serviceman took his measurement. Wait until the burner and circulating fan have been operating for about ten minutes.

Here is a chart to record your readings:

Flue-Gas Temperature Readings

Date	Flue-Gas Temperature

As soon as the internal surfaces of the heat exchanger accumulate enough soot to reduce the heat transfer, the flue-gas temperature will rise.

How to interpret and correct. If the temperature level *increases* by 50°F (28°C), put in new air filters. If this doesn't work it's worthwhile increasing the air-flow rate by adjusting the air-circulating fan speed as shown in Figures 49 and 50. *Again, before making any adjustments, be sure the master power switch to the furnace is off.* After making the adjustment, check the belt tension and alignment.

If the flue-gas temperature rises by as much as 100°F (50°C) due to accumulated soot, you should consider a partial furnace cleaning. To do this, you must be sure you can find the access to the furnace surfaces. (The service mechanic can point this out on his regular visit.)

Usually some breeching must be removed for access to the cleaning openings. Before starting, overheat the house for about an hour, turn the thermostat right down, let the furnace cool off, and be sure the power is off.

A wire brush with a long flexible shaft and an ordinary vacuum cleaner are all you need. Figures 11 to 14 show the operation during the summer overhaul. It's a good idea to watch your service mechanic before you tackle the job yourself.

Measure the circulating-air temperature

The stack gas thermometer can also be used to check the temperature of the heated air in the ducting just above the furnace. Here an alternative is a regular meat thermometer. In a furnace that is maintaining its performance level this air temperature should stay steady throughout the winter. If it falls, furnace efficiency is falling and the above corrective measures can be taken. If it rises, check the air filters.

Do you need a mid-winter servicing?

In many cases a mid-winter servicing of oil furnaces will save both money and fuel.

To see if this applies to you, here are four simple tests that you can easily perform. The week between Christmas and New Year's is an excellent time to do these checks.

Check the colour of your chimney smoke

If the smoke at the top of your chimney in cold weather is white, then your furnace could be operating satisfactorily. If, on the other hand, the smoke is grey or, worse still, black, then the burner needs re-tuning.

Look at the tip of the flame

Open the inspection door carefully during furnace operation (it will be hot). Check the tip of the flame.

If it is black and the flame is a dull yellow, your burner needs re-tuning and the furnace probably needs re-cleaning. A high yellow flame with no trace of smoke is what you really want.

Check the heat-exchanger for soot

Shut off the power to the furnace and stick a flashlight in the inspection port. Anything more than a very thin film of soot on the heat exchanger (at the top of the combustion chamber) indicates that the furnace needs cleaning.

Persistent rise in flue-gas temperature

If you are measuring the flue-gas temperature you are in the best position of all to know if your furnace needs a mid-winter servicing. A flue-gas temperature rise of more than 100F° (56C°) despite corrective ac-

tion, means that your furnace needs re-cleaning and the burner re-tuning.

If any one of these tests makes you think that your furnace is performing inefficiently, call in your serviceman for an efficiency check and/or furnace overhaul. You will have to pay for this.

A mid-winter overhaul should, however, pay for itself over the remainder of the heating season and will certainly save precious fuel oil.

GAS-FIRED SYSTEMS

Control systems

Do not attempt to adjust any of the control systems. If the burner fails to ignite when the thermostat calls for heat, first check that the pilot light is on. If it is out, attempt to relight it. To do this you must follow exactly the instructions on the rating plate attached to the furnace. If the pilot cannot be relit you should get in touch with the service department of your gas utility who maintains a 24-hour service for emergencies of this sort and will repair any faults with the system. Even if you do manage to relight the pilot light, inform the gas utility. A service check may be needed.

Burner servicing

Again, don't start servicing the burner yourself. If it's well adjusted you won't have any trouble through the heating season, as long as you follow a few simple steps.

The burner must have an adequate supply of air. This is equally important for oil-fired and gas-fired systems. The specifications for air supply to gas systems are much the same as those for oil systems described in the

foregoing section of this chapter. The only difference is that where you have two openings to the basement or to outside, one must be above the draft hood.

The heat-distribution system

Here again, as with the oil furnace, the billpayer can do a good deal to help himself. In fact the things you can do:

Keep the air registers clear,

Keep the air filters clean, and

Lubricate the circulating fan

are exactly the same as for a forced-air oil system. See the preceding section of this chapter.

Check your furnace condition

Measure the flue-gas temperature

If your furnace has a free-standing vent hood, as in Figure 44, you can undertake weekly flue-gas temperature measurements as described for the oil furnace and use the same recording chart.

If your furnace has a "built in" draft hood, as in Figure 45, you can measure the flue-gas temperature after dilution with air. In this case the temperature is not as reliable an indicator of performance as that measured with a free-standing draft hood but it should still indicate changes in furnace performance.

How to interpret and correct

If the temperature level of undiluted flue gas increases by 50°F (28°C), put in new air filters. If the temperature level of diluted flue gas increases persistently by 25°F (14°C), put in a new air filter. In either case, if this doesn't work and the temperature continues to rise, you should call your gas utility.

Measure the circulating air temperature

For gas furnaces with either type of draft hood you can easily measure the temperature of the heated air in the ducting just above the furnace. A simple meat thermometer will do the job.

How to interpret and correct

In a furnace that is maintaining its performance level, this air temperature should stay steady throughout the winter.

If the air temperature drops by more than 20°F (10°C) you should call your gas utility. If on the other hand the air temperature rises by more than 20°F (10°C) you should check the air filters. If this does not work and the temperature continues to rise you should call your gas utility.

You should not attempt to clean or adjust gas furnaces. If you suspect that something is wrong, call your gas utility immediately.

GOOD MAINTENANCE MAKES SENSE IN 4 WAYS

First, the billpayer cuts his costs of operating the equipment.

Secondly, our environment is greatly improved because a well-maintained system sends out less pollution into the air.

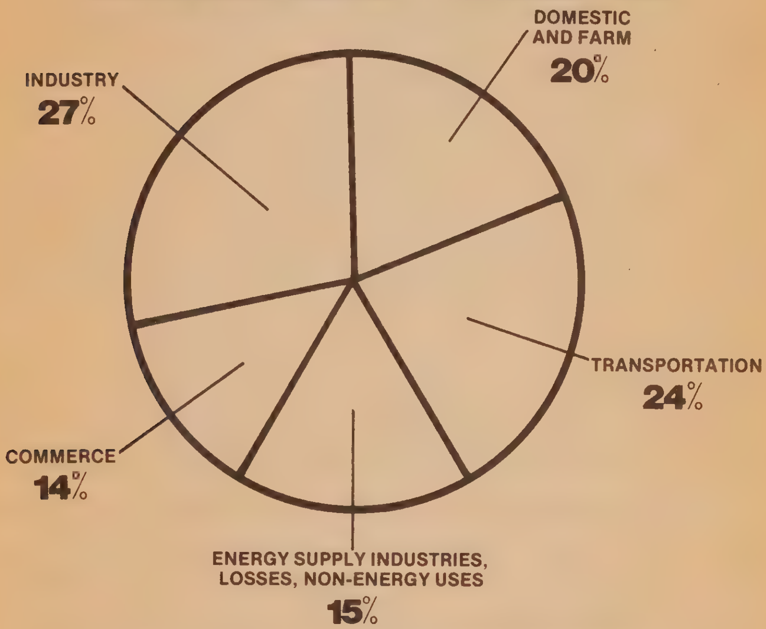
Third, the safest system is a well-maintained one.

Fourth, an efficient system uses less oil or gas. This means Canada can conserve some of its fast-dwindling energy resources.

WHY CONSERVE ENERGY?

While this book concentrates on energy savings in the home, it is important to put the domestic sector in perspective. The consumption of energy in the form of electricity and heating fuel in Canadian homes and farms represents about one fifth of the total energy consumption in Canada. Gasoline for private cars represents a further large share of the transportation sector.

CANADIAN ENERGY CONSUMPTION



This means several things. First, saving energy around the home can have significant impacts on the national scene. If everyone cuts his domestic consumption by only 10 per cent through furnace tuning, insulation, lower temperatures or other measures, the result would

be a cutback of about 2 per cent in total national consumption. While this may not seem large in percentage terms, it is actually a tremendous energy and dollar saving for Canada.

Second, the other sectors of our economy are also large energy users; both industry and transportation surpass residential consumption. This means that there is both an opportunity and a responsibility for conserving energy in those sectors. Accordingly, the Government will be implementing a combination of voluntary and mandatory measures to bring about significant savings in these areas. Each of us can also contribute by carrying our conservation concerns over to our job. Whether you drive a truck or manage a business, work in an office or a factory, there are numerous ways that you can conserve energy each day. Take a lead from the measures in this book and start a conservation campaign at work.

Third, as private citizens we consume almost 20 per cent of Canada's energy budget in our homes and over half of the transportation energy in our cars, giving us a total direct consumption of about one third of the total. The other two thirds of Canada's consumption is used to produce the goods and services that we as consumers demand. This means that our potential for conservation is not limited to that one third of the total energy budget that we consume directly. By careful purchases, consumer action, recycling and choosing energy-efficient travel modes we can have an impact on that other two thirds.

Almost all of us believe to some degree in conservation. For some people, it is a simple matter of saving

money; for others, a husbanding of resources now so that we will not find ourselves short in the future. For yet other people, conservation represents an ideal, a way of life to which we should aspire. Whichever is your view, there are many sound reasons to support energy conservation as an important new direction for Canadian energy policy. Let us focus briefly on just the most obvious of these.

RESOURCES

First, there is the sheer physical volume of energy that is being demanded in a world of ever more people, of higher incomes and of more technology. With every increase in our rate of consumption, in Canada as elsewhere, it becomes harder to find, produce and transport the necessary energy materials. For the first time we are in a position where projected future demand levels cannot be satisfied by conventional energy sources. Canada will face possible shortages of oil and natural gas within the next decade unless non-conventional or potential frontier resources can be developed and delivered in sufficient quantity. Even future electricity supply is not assured. Feasible hydro sites are now almost totally developed and uranium reserves are limited.

COSTS

Second, even if we could locate energy resources of suitable quantities and qualities, their costs would be monumental. It has been estimated that to meet the capital requirements for energy in Canada to 1985 alone, we will have to spend over $100 billion, that is about $20,000 per existing household just to supply energy.

This effect gets worse with time because, as we move to lower quality and more remote sources of energy, it

will cost us more and more energy to obtain energy. That is, since we have to invest not only dollars but also energy units in order to mine coal or tar sands, drill wells, operate pipelines or whatever, the net costs of energy delivered to the consumer will be still higher.

The impact of this on our economy will be severe, both in terms of inflation and because it means fewer dollars for schools, hospitals and other industrial projects. In effect, it implies a return to the situation in which Canadian investment would be concentrated in the resource sectors of the economy.

In view of the resource and cost factors, conservation offers a low-cost and low-risk alternative to continued high-demand growth.

ENVIRONMENT

Third, assuming the resources were available and could be produced at a cost that we were willing to pay, to produce them and then consume them would involve large-scale environmental impacts.

Obviously to the extent that we conserve energy and defer or cancel energy development plans the environmental impacts of production and transportation can be avoided. Moreover in almost every instance sound energy conservation at the point of use also supports environmental protection. True, in some cases environmental protection techniques seem to require more energy, but in most cases this arises only when such techniques are added on to the end of an existing process. The emission devices on automobiles are good examples of this approach. When more thought is given to the process as a whole, the apparent conflict between energy conservation and environmental protection usually disappears.

In summary, energy conservation can be viewed as the purest form of environmental protection.

SOCIAL BENEFITS

Finally let us examine the idea of quality of life. This is perhaps an over-used phrase, but the fact that it is over-used means that, for many Canadians, there is a feeling that our higher incomes and greater wealth have not been producing all that we had hoped that they would. For example, we now have larger, more powerful automobiles, but it takes us just as long to get to work and there are ever more aggravations on route. Our luxurious homes are burgeoning with appliances, our garbage bags burst with waste from the affluent society. But has all this consumption and convenience brought us closer together or has it alienated us from the natural world and each other?

There is sound evidence to think that most indications of quality have begun to turn downward, that they are by no means as closely related to energy consumption as we once thought. Indeed, it now seems that efforts at moderating our energy consumption — smaller cars, more mass transit, better built houses, less waste production, more personal involvement — will contribute to the quality of life at the same time as they save energy.

There are still other reasons to support a serious and continuing effort at energy conservation which cannot be discussed fully here. Energy conservation is likely to require the substitution of labour for capital and will thus account for an increase in jobs in Canada. By avoiding the need for enormous volumes of imports, energy conservation will reduce the dangers of international blackmail and confrontation. And so forth.

Most of us are aware that such benefits exist, though we perhaps do not often separate them into neat categories. Individually, any one is probably sufficient to justify increased efforts at conservation. Together they indicate that conservation will be fundamental to the Canada we are all trying to build.

A WORD ABOUT THOSE CONSERVATION DOLLARS

One point to watch. If we are all going to save money by conserving energy, we have to be careful how we spend that money. If we turn around and spend it on high-energy products or activities (such as a second car, a heated pool, a snowmobile) we might end up offsetting the energy savings we have made. A good conservation ethic means that we think about the likely energy implications of our purchase decisions.

Try to channel your conservation savings into low-energy investments like paying off the mortgage, further education, music lessons or hobbies, more healthy food, or perhaps even donate it to your favourite charitable cause.

In short put your conservation dollars back into conservation.

FEEDBACK

Once you have had a chance to read this book and put it to use, we would like to receive your comments.

Was it useful? .... Yes______ No______

Was it easy to read? .... Yes______ No______

Was it easy to understand? ...... Yes______ No______

Was it too technical? .... Yes______ No______

Or was it too simple? .... Yes______ No______

Do you have an oil or a
gas furnace? .... Oil______ Gas______

Did you use the book when your service mechanic came to service your furnace?

Yes______ No______

If yes:
What was his response?

____

____

____

Did he fill out the check list? .... Yes______ No______

Did he take the measurements outlined in the book?

Yes______ No______

Comments: ____________________________________

____

What was the measured efficiency of your furnace after he had serviced it?

____

Were you pleased with the service he provided?

Yes______ No______

Comments: ______________________________________

____

____

If the service was unsatisfactory have you switched to another company? .... Yes______ No______

Did the service man carry out any extra servicing operations to those described in this book?

Yes______ No______

If yes, please describe:

____

____

Did you undertake the self-service and maintenance steps?

Yes______ No______

If yes, which ones?

____

____

Would you like to see other consumer guides similar to this one published? .... Yes______ No______

Other comments:

Send to:

Furnace Feedback,
Office of Energy Conservation,
Department of Energy, Mines and Resources,
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Ottawa, Ontario.
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100 Ways to Save Energy and Money in the Home was our first major publication of which there are over 2,000,000 in print. The book has tips on how you can stretch Canada's energy resources and put money in your pocket. It deals with a number of topics from cooking to waste recycling. Every household in Canada should have one!

The Garbage Book is OCE's third major publication and helps us realize that it takes energy to produce and dispose of garbage. The less we use and discard the more we save. We can all save energy and money by throwing out less.

Keeping the Heat In is a complete do-it-yourself manual telling us how to re-insulate our homes to save money and energy. Much of our resources are wasted by "leaky" houses. Many home-owners can cut their heating consumption in half by following the advice in this book.

The Car Mileage Book is our most recent publication. It tells us how to buy, drive, and maintain our cars so

they are more reliable and use less fuel. We can cut the gas we use by as much as 25% through careful driving and proper maintenance.

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